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Popular Mechanics

THE 2011
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AWARDS

20 BOLD IDEAS

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DRAGON**

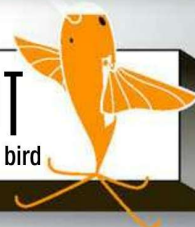
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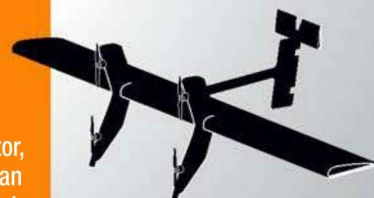
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More things in heaven and earth...? Definitely

A couple of months ago, Cape Town was awash with astronomers, aeronautical engineers, astrophysicists, chemists, philosophers and other interesting people, all of them eager to share their knowledge – and in some cases, way-out theories – on everything from space elevators to the existence of extraterrestrial life. The magnet was the 62nd International Astronautical Conference, and it was a big deal.

What we found particularly satisfying was the willingness of the participants to engage with the public, which they did with great enthusiasm and good humour. Among them were Nasa chief and former astronaut Charles Bolden, and Dr Catherine Coleman, a cheerful and musically accomplished American astronaut who visited a local high school to talk about living and working in space. For the record, she once took four flutes into orbit aboard the International Space Station (ISS), and is probably the only space traveller who knows how it feels to play in zero gravity. In May this year, she left the ISS after logging an unbroken 159 days in space.

Then there was space-inspired poetry, a variety of astronomy and related events, space music, space art, and even a special-edition "space burger", which we found at a little coffee shop near the convention venue (it was delicious, although the accompanying "asteroids", aka gherkins, looked a little dodgy).

While all this was happening, conference delegates were discussing the myriad human challenges – both physical and psychological – that accompany space travel and survival in the unimaginably harsh environments of Mars and the Moon, as well as arcane issues of space law, space debris (there's a lot of it out there, and plenty still to come), revolutionary propulsion systems, and much more.

Shakespeare's Hamlet said: "There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy." Frankly, he didn't know the half of it.

Alan Duggan

aland@ramsaymedia.co.za



Right: "Astronaut" Kechil Kirkham (in real life, media liaison person for the International Astronautical Congress) caught up on her reading during a break.

Far right: PM Editor Alan Duggan expresses mild affection for McLaren's MP4-12C supercar after a "vigorous" track outing in England.



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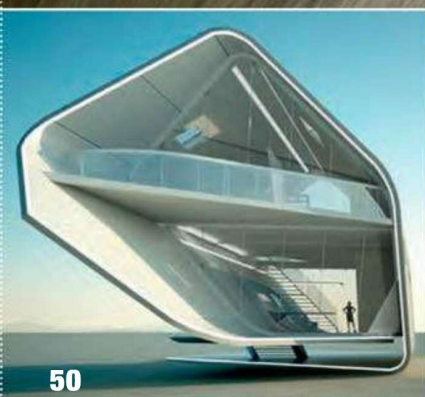
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WIN

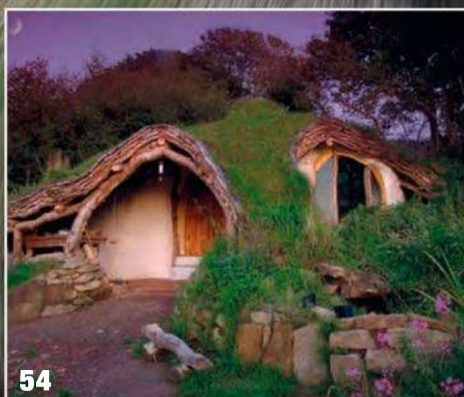


5 MX350 Razor scooters and 5 Sole Skates, all worth R19 000 (see page 83)

5 Smartlocks valued at R3 790 each (see page 87)



50



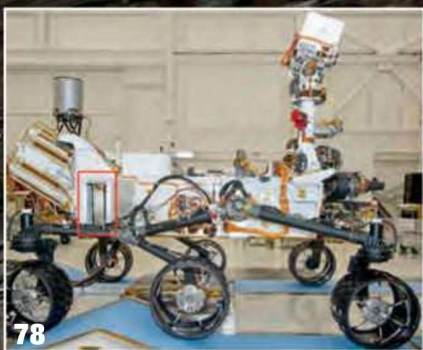
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Cover: launched atop a Falcon 9 rocket, the SpaceX Dragon capsule is designed to carry seven astronauts. SpaceX hopes to dock Dragon with the International Space Station. Rocket and capsule illustration by Vladimir Shelest. Icons by Dogo. This page: McLaren's elegant and breathtakingly quick MP4-12C supercar explores a country road. Picture: McLaren Automotive.

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REMEMBER THE HUMAN FACTOR

Your "Flight risks" article (September issue) got me thinking, and I'd like to share my opinion on the subject. You ask whether modern planes are over-engineered. I think the answer is "no", but it depends on your understanding of the term. Over-engineering can be defined as "making something more robust or complicated than necessary for its application". This is highly desirable in aviation because it ensures sufficient factor of safety and sufficient functionality, and mitigates design errors. If anything, modern aircraft could benefit from even more engineering.

However, over-engineering violates the principles of value engineering and simplicity. In other words, if you're not careful, you end up with an aircraft that is either unsafe, lacks functionality, is too expensive, or has too many possible failure modes to easily keep track of. Aviation engineers seek to balance those seemingly opposing considerations: prioritising and optimising each factor, often at the expense of another.

In my opinion, modern commercial aircraft are as well engineered as the fare-paying-passenger allows them to be. The current market demands cheap flights, fast turnarounds, no delays and clean air. Despite those demands, we still expect impeccably safe aeroplanes. The aviation industry is doing its best to meet these demands, and still stay competitive. How then are we, as passengers, affecting the design of aircraft, and the airline industry in general? If we indeed influence these things, when an aircraft crashes, what degree of responsibility is ours? The persistence of the investigators in the Air France Flight 447 inquiry is really admirable. Now that the black boxes have been found, we know pretty much exactly what happened. The "what" was pretty shocking (and a bit of a wake-up call). The pilots went from under-stimulated to over-stressed in a split second. Furthermore, they were not given the right information to enable them to recover the plane, when the computers no longer could. The man-machine interface failed terribly. The problem the investigators now face is to explain why it happened. The investigation has subsequently been handed over to human factors specialists for further analysis.

DAVID DALLAS

PILOT, AVIATION SAFETY OFFICER, ACCIDENT INVESTIGATOR
CAPE TOWN

Editor's note: This letter has been shortened. To request the full text, please e-mail kated@ramsaymedia.co.za

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Yes, but what about Nature?

Your article, "Drilling down: fact vs fiction in the great fracking debate" (October issue), addresses the common claims for and against hydraulic fracturing, and attempts to present the facts in an unemotional fashion. This is a good way to approach any debate; leave out the emotions and simply present the known facts.

However, in this case we are not aware of all the hypotheses. For example, no one can predict the forces of Nature. How would the analysis of those 10 claims be affected if there was an earthquake in the areas where hydraulic fracturing was being performed? For one, the safety of the groundwater from contamination by fracking fluids could no longer be guaranteed. That factor alone makes the practice too risky. No one is denying that we need to find alternative sources of energy, but let's not put another part of this planet at risk for the sake of profit.

TONY BASTOS
VENTERSTAD

Of sweat and memories...

Your articles on South African inventions (October and November issues) brought home to me how far we have come in technological terms since the 1960s, when I was privileged to be one of the first to use Trevor Wadley's Mk 1 tellurometer while doing a survey of the Orange River from Alexander Bay to Upington.

There were very few roads through the Richtersveld, and we had to carry all our equipment as we moved up river. The tellurometer team consisted of eight men, all of whom earned their money in sweat every day, sometimes in temperatures that touched the 50-degree mark. Each station (two tellurometers) needed two men, each station tripod needed a man, each station needed a truck battery to supply power, and the batteries needed a generator to charge them, complete with fuel and oil.

It often felt as if this "new invention"

was specifically designed to test one's mettle. After all the physical exertion, you had to do all the associated calculations, determine the day's relative humidity, and *still* not know why things were not working as they should. It was wonderful!

These days, surveyors carry their equipment in their pockets, arrive at the site, press a button, and the job is done. Modern technology is marvellous, but for me, it has taken the adventure out of doing the job.

JOHANN MASUREIK
PINELANDS



Alien horror, revisited

A cover headline for your October issue reads "Area 51 – what *really* happened?" From what I can gather, nothing much. We're treated to an utterly loony story inspired by (a) the cynical pursuit of money or (b) the ravings of people suffering from borderline psychoses. I'm amazed that a respected magazine such as PM would devote those valuable pages to an article that would be better placed in a publication focusing on the cultivation of hallucinogenic mushrooms.

Please don't take this personally. Your magazine is generally fantastic.

ADAM CHRISTIE
SANDTON

Go on, surprise me

I had to laugh when reading your comment to David Hepple's letter. I have to partly agree with his statement that the article, "Spies at war" (August issue), was a bit out of the ordinary for PM's Tech Watch section. The Navy SEALs article in September didn't get my adrenaline pumping, either; I found the strategy and technology more appealing (than the soldiers).

However, my amusement had more to do with your reply, in which you stated that "PM's audience is primarily male and warm-blooded". Well, I am a female subscriber of POPULAR MECHANICS – and proud of it! You may not hear us roar or see us beat our chests, but the gadget-loving gals are out there.

So here's a challenge to PM: how about articles on tech-savvy women and their creations? It should get your "warm-blooded" subscribers interested, even if only for a while. I'm not talking about fluffy bunny projects or cute DIY... but



Killer bike?

Jay Leno writes entertainingly about his Vincent Black Shadow ("Me and my Shadow", October issue), reminding me of an infamous Vincent that lurked in Pretoria about 45 years ago. It was reputed to have killed two of its owners, and when I last heard, it was displayed on top of a coffin in Pretoria's Club Motors. If any of your more mature readers can shed light on this sinister machine, I'd be glad if they would share what they know.

RUDY VAN NIEKERK
CENTURION

how about female scientists, female engineers, female pilots? By the way, interesting article on Annie Jacobsen's Area 51 book; I was surprised to see it in POPULAR MECHANICS. Let's see if you can surprise me again in the next issue.

NADINE SPIRES
JOHANNESBURG

Smoke it up (again)

In your issue of August 2010, you published a DIY article on how to build your own smoker, providing plans, ideas and tips. I built one myself, and I can tell you one thing – it works like a bomb. My father-in-law and I were chatting over a cold one (*aka beer* – Editor) a while back about cold smokers, and wondered how to go about building one. How about a follow-up article on a *cold* smoker project?

EUGENE VERMAAK
VANDERBIJLPARK

Editor: We're happy to look into it.

Baby steps

In response to your "So what?" editorial comment in PM's green issue (September), here are three easy ways for everyone to help clean up the planet.

- At the shops, do not allow single items to be packed into that poor excuse for a plastic bag. By now, taking your own bags to the shops should be a habit.

- Go for glass when buying soft drinks; cans are better only if you actually get around to recycling them. Rather than tossing it into the bin, place it alongside, and within minutes someone less fortunate will come along and recycle it for you. I do this almost every day.

- Buy rechargeable batteries. They cost

roughly 10 times less than their disposable counterparts when measured over their lifetime. In fact, this is something that should be taken into account whatever you buy.

RUDOLPH BOTHA
VIA E-MAIL

Embarrassing glitches dept

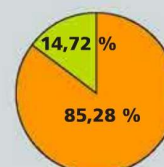
In the picture credits for our November issue, we inadvertently identified the aircraft on our cover as the two-seater *Symmetry*, designed by Cory Bird. In fact, we showcased the cleverly engineered *Lucky Stars*, brainchild of aviation enthusiast Mark Stull. Sorry about that. **PM**

MONTHLY POLL

Are you for or against fracking in the Karoo, and in general?

For. Fracking is the best way to supply SA's energy needs sustainably and to create work. 14,72%

Against. Besides environmental implications, I'm particularly concerned about the possible effect on SA's bid to host the Square Kilometre Array (SKA) telescope, which will be located in the Karoo. 85,28%



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1929 Some of PM's early advertisements competed with the magazine's editorial content in their revelations of scientific breakthroughs. This ad for example, offered our readers a free book from the Perfect Voice Institute explaining how to achieve the vocal power of a Caruso (apparently it was all thanks to a system of voice training that involved exercising your hyoglossus muscle).

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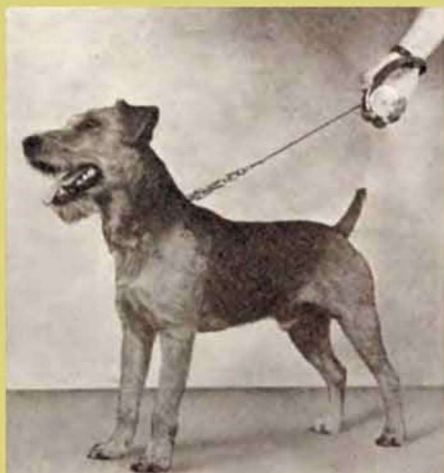
Special Home Issue

Instant Office in a Closet
 3 Great Hobby Corners
 Practical Sound Proofing
 10 Brand New Materials



1965 If you thought "working from home" was a relatively new concept, think again. Some 46 years ago, we published plans for the construction of this versatile office-in-a-closet, courtesy of a well-known industrial designer. Interestingly, the concept remains relevant in the age of computers.

1941



This disarmingly simple device employs a leash wound on an automatic reel to keep Rover in check. When it's time to apply the brakes, you have only to flick a lever, and when you want to give him free rein, you flick it the other way. The lightweight aluminium reel comes with a comfortable wrist strap, two metres of waterproof cord, a built-in GPS and a flatulence monitor. (Actually, we made up the last two.)



1939 Another example of timeless ingenuity. Intent on safeguarding his health while serving customers, this cunning cashier stretched a sheet of clear cellophane across the upper part of the grille. This not only protected him from draughts, we revealed, but also kept him from catching colds "and other diseases" from customers. No mention is made of the colonies of bacteria that tend to lurk on banknotes. **PM**

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■ EARTH SCIENCE

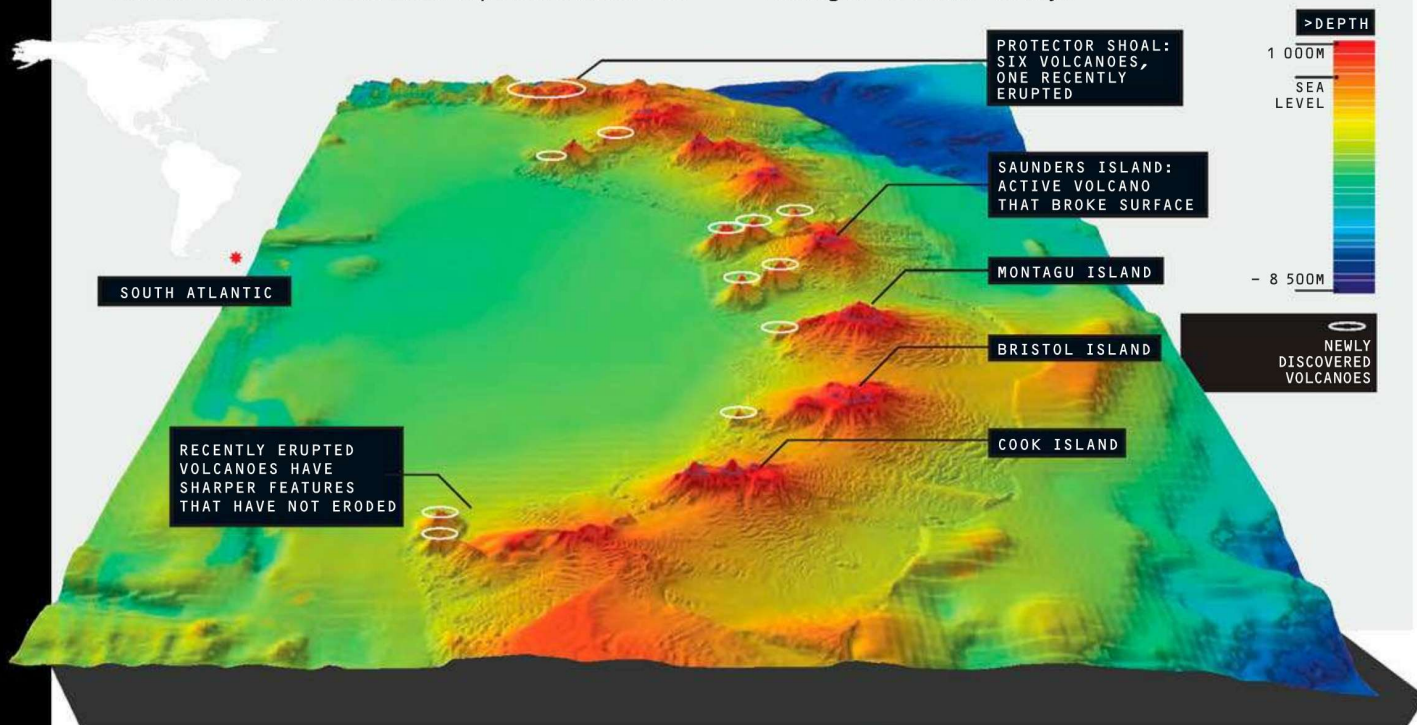
EARTH'S SUB-SEA PEAKS

NEW SCANS SHOW A VOLCANIC RANGE LURKING BENEATH THE SURFACE OF THE SOUTH ATLANTIC.

BY DOUGLAS MAIN

Scientists have found underwater volcanoes – some up to 3,2 km tall and showing evidence of recent eruptions – in the remote South Atlantic. Researchers working with the British Antarctic Survey generated 3D images of the seafloor with multi-beam sonar. Expedition leader Phil

Leat says one volcano's summit lurks just 48 m below the surface and that it could form an island if it erupts. Leat plans to return soon to catalogue marine life; new species have been found nearby. "There are countless discoveries waiting to be made," he says.



■ QUICK HITS



VIDEO

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BRAIN BRAKING

→ When a driver slams on the brakes, there's a lag between the decision to stop and the foot's reaction. Neuroscientists at the Berlin Institute of Technology are trying to reduce that delay. With electrodes attached to their scalp and legs to measure synaptic and muscular triggers, drivers in a simulator braked 130 milliseconds faster than their feet could press the pedal. That equates to about 4 m at 100 km/h, enough to avoid a collision.



FUNCTIONAL TATTOOS

→ Researchers at Northeastern University in Boston have developed an injectable "tattoo" that monitors the body. The invisible mark contains sensors that glow when a certain molecule is detected; a filter on a cellphone camera enables users to see the mark. Early applications could include non-invasive blood-sugar monitoring for diabetics.



ROBOTIC BAKER

→ The quest for a kinder, gentler robot took a step forward when MIT's BakeBot successfully made a giant chocolate biscuit from scratch. What sounds like a simple task for humans actually requires sophisticated hierarchical planning by the robot's designers, and impressive dexterity to assemble the ingredients, cream the butter and sugar, and shape the dough. Using a PR2 robot from California-based Willow Garage, researchers programmed BakeBot to use laser and stereo cameras to locate and identify the ingredients. –

ALEX HUTCHINSON

Flight risk

CHINOOK HELICOPTERS ARE KEY TO AMERICA'S ACTIVITIES IN AFGHANISTAN. AFTER A TRAGIC INCIDENT THIS YEAR, THE US ARMY HOPES TO MAKE THEM LESS VULNERABLE.

BY SHARON WEINBERGER



America was horrified when Taliban forces used an unguided rocket-propelled grenade (RPG) to shoot down a CH-47 Chinook in August, killing 38 people. The attack highlighted a defensive flaw in US Army helicopters: although they're capable of warding off sophisticated weapons, such as guided missiles, the helicopters are still susceptible to low-tech attacks from RPGs or small-arms fire.

Guided weapons

Chinooks in Afghanistan are equipped with the Common Missile Warning System, which detects radar- or infrared-guided missiles and counters them with chaff (bits of fluttering metal) and flares. The US Army plans to finish installing an improved system – the Advanced Threat Infrared Countermeasures Quick Reaction Capability – on all the helicopters deployed in combat areas by the end of this year. The new hardware employs a laser to jam infrared-guided targeting systems.

Unguided weapons

Hostile Fire Quick Reaction Capability alerts pilots to an incoming warhead so they can manoeuvre out of its way; the system is due for installation on US Army helicopters. But the more advanced Hostile Fire Detection System – which tells pilots the direction of inbound, unguided rockets by quadrant and clock position – is facing delays. The Pentagon postponed a June meeting to consider buying the system, saying the Army and industry did not have enough information.

BALL OF POWER

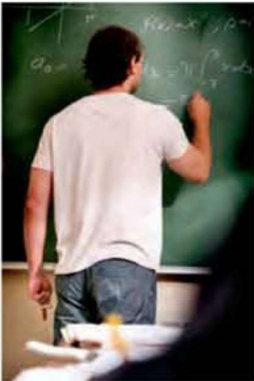
The sOcket soccer ball, which generates electricity with each kick, is going global.

Co-developed by four Harvard graduates, about 10 000 units of the 2010 PM Breakthrough Award-winning invention will be distributed to electricity-poor communities worldwide by the end of 2011, and a limited number will be for sale on www.sOcket.com.

The production version delivers 10 times as much juice as the original did by replacing a built-in, bidirectional shake-to-charge device with gyroscopic technology. "Instead of just capturing energy from one dimension of motion, it's capturing energy from all possible dimensions," says co-developer Julia Silverman. "The prototype could power an LED lamp; the new ball can handle multiple LEDs and a water purifier."

– ALLIE HAAKE





"Without inspiration the best powers of the mind remain dormant. There is a fuel in us that needs to be ignited with sparks - which in this case is education"

- Prof Ian Alderton,
Acting Executive Dean

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Lunar lost and found

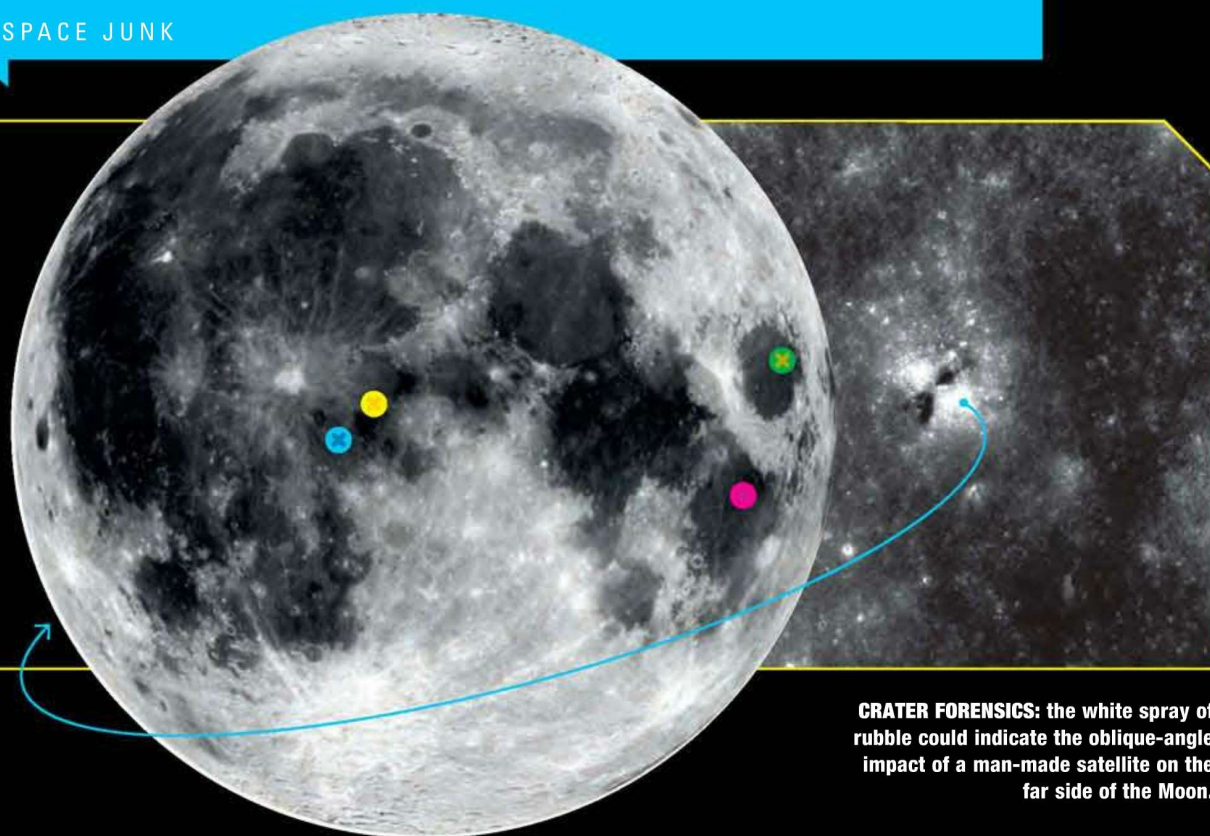
AN ORBITER LOCATES THE SUSPECTED RESTING PLACE OF A PROBE THAT CRASHED ON THE MOON 44 YEARS AGO.

Nasa's Lunar Reconnaissance Orbiter Camera (LROC) is taking the highest-resolution images of the Moon's surface from space, scouting locations for future astronaut or robot landings. But LROC may also have discovered the resting place of Lunar Orbiter 2, a Nasa spacecraft that disappeared on the far side of the Moon in 1967.

Orbiter 2 was in an intentional death dive, but Nasa never knew the site of its impact. The debris

from an impact angle of 45 degrees or more spreads out like butterfly wings, says LROC science operations centre manager Ernest Bowman-Cisneros. Although losing equipment is unavoidable, examining its crash sites is useful. "They are great laboratories for studying small impacts on the Moon," says Mark Robinson, LROC's principal investigator. *BY LESTER BLACK*

SPACE JUNK



CRATER FORENSICS: the white spray of rubble could indicate the oblique-angle impact of a man-made satellite on the far side of the Moon.

NOTABLE LUNAR CRASHES

✱ APOLLO 14

Country: US
Launch: 31 January 1971
Crash: 4 February 1971

INTENTIONAL

The upper stage of Apollo 14's Saturn IVB rocket creates a 35 m-wide crater and causes a moonquake that reveals seismic details about the lunar interior.

✱ SURVEYOR 2

Country: US
Launch: 20 September 1966
Crash: 22 September 1966

UNINTENTIONAL

The soft touchdown is supposed to aid the Apollo programme, but the spacecraft crashes when one of three thrusters fails to ignite.

✱ LUNA 15

Country: USSR
Launch: 13 July 1969
Crash: 21 July 1969

UNINTENTIONAL

The main retrorocket of this lander, used in the Soviets' second attempt to bring Moon rocks back to Earth, fails to fire.

✱ CHANG'E 1

Country: China
Launch: 24 October 2007
Crash: 1 March 2009

INTENTIONAL

The first Chinese robotic lunar mission transmits 175 gigabytes of information before it plummets to the surface.

PERSONAL PRIVACY

Putting a name to the face

WILL HARNESSING IDENTITY-RECOGNITION SOFTWARE TO SEARCH ENGINES FURTHER ERODE PRIVACY? BY MARY BETH GRIGGS

A RECENT STUDY led by Carnegie Mellon University (CMU) associate professor of information technology Alessandro Acquisti used facial-recognition software (FRS) to link student volunteers to their Facebook profiles – within three seconds. The experiment demonstrated the remark-

able – and some would say, alarming – possibilities presented by the confluence of improved FRS, ever-faster Internet connections and the rise of cloud computing.

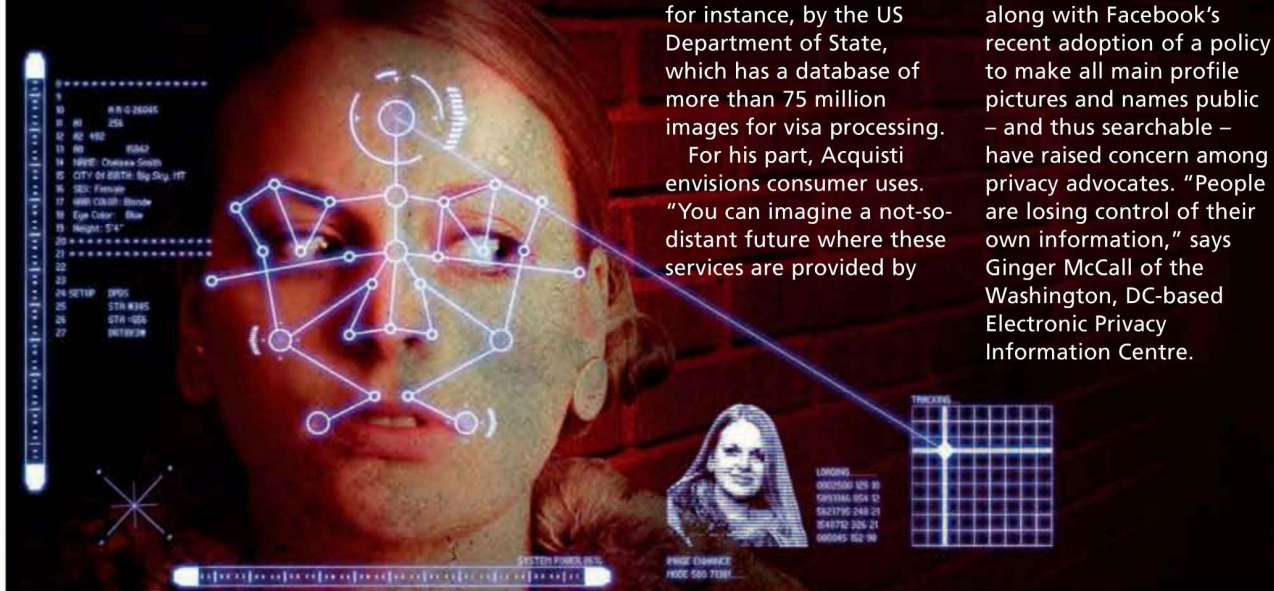
Acquisti's team amassed information from Facebook profiles to build a database that included CMU

students' home towns, images and names. When researchers snapped a digital photo, the FRS scoured the database to identify the person. The technology would seem to have many potential applications, especially since FRS is already widely used in law enforcement and, for instance, by the US Department of State, which has a database of more than 75 million images for visa processing.

For his part, Acquisti envisions consumer uses. "You can imagine a not-so-distant future where these services are provided by

search engines," he says.

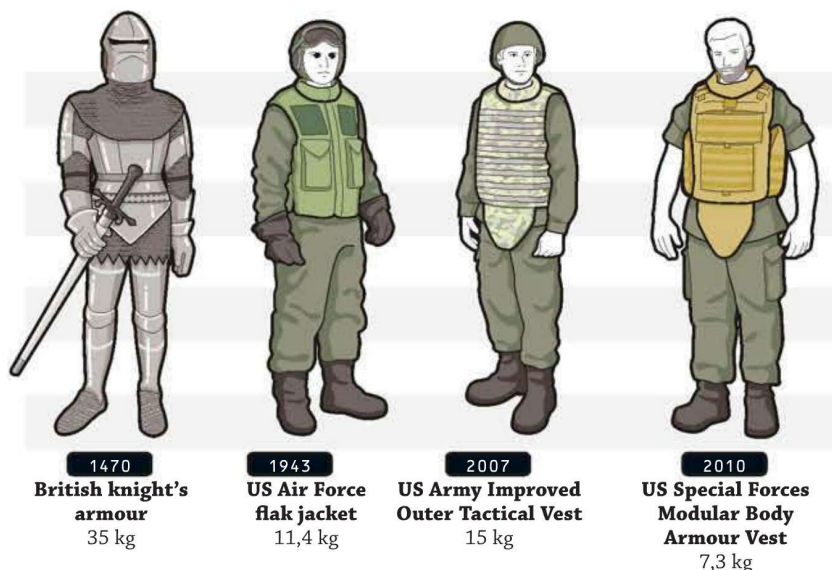
Speaking of search engines, Google acquired PittPatt, the FRS that Acquisti used in the study, at about the same time he presented his findings. Google also has bought at least two other companies that developed FRS software. Google's actions, along with Facebook's recent adoption of a policy to make all main profile pictures and names public – and thus searchable – have raised concern among privacy advocates. "People are losing control of their own information," says Ginger McCall of the Washington, DC-based Electronic Privacy Information Centre.



PAST LIVES

Sir Sweats-A-Lot

Soldiering is hard work. But fighting in armour that's heavier than a large bag of ready-mix concrete? That's positively mediaeval. A recent study in England put re-enactors of 15th-century battles on a treadmill and found that a fully suited subject expended twice the energy of an unarmoured man-at-arms. Today's body armour uses lightweight ballistic ceramic plates to guard the torso, but a soldier's legs bear no armour, increasing mobility and stamina. Knights weren't so lucky: they wore as much as 8 kg of metal on their legs. – MBG



HP recommends Windows® 7.



welcome to the beat
generation



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VIDEO

> Watch a video on www.popularmechanics.co.za explaining the new technique developed to watch how cells move.



Words maketh the killer?

COMPUTERISED TEXT ANALYSIS COULD IDENTIFY PSYCHOPATHS BY HOW THEY SPEAK

As words can be the soul's window, scientists are learning to peer through it: computerised text analysis shows that psychopathic killers make identifiable word choices – beyond conscious control – when talking about their crimes. This research could lead to new tools for diagnosis and treatment, and may have implications for law enforcement and social media.

The words of psychopathic murderers match their personalities, which reflect selfishness, detachment from their crimes and emotional flatness, says Jeff Hancock, Cornell professor of computing and information science, and colleagues at the University of British Columbia, writing in the journal *Legal and Criminological Psychology*.

They analysed stories told by 14 psychopathic male murderers held in Canadian prisons and compared them with 38 convicted murderers who were not diagnosed as psychopathic. Each subject was asked to describe his crime in detail. Their stories were

taped, transcribed and subjected to computer analysis.

Psychopaths used more conjunctions such as "because," "since" or "so that", implying that the crime "had to be done" to obtain a particular goal. They used twice as many words relating to physical needs, such as food, sex or money, while non-psychopaths used more words about social needs, including family, religion and spirituality. Unveiling their predatory nature in their own description, the psychopaths often included details of what they had to eat on the day of their crime.

"Previous work has looked at how psychopaths use language," Hancock said. "Our paper is the first to show that you can use automated tools to detect the distinct speech patterns of psychopaths." This can be valuable to clinical psychologists, he said, because the approach to treatment of psychopaths can be very different.

● *Sources: Newswise and Cornell University.*

■ CANCER RESEARCH

CELLS ON THE MOVE

FROM HEALING TO BODY DEFENCES, WE RELY ON CELLS' ABILITY TO CRAWL



For better and for worse, human health depends on a cell's motility – the ability

to crawl from place to place. In every human body, millions of cells are crawling around doing mostly good deeds, but if any of those crawlers are cancerous, watch out.

"This is not some horrible sci-fi movie come true, but... normal cells carrying out their daily duties," says Florida State University cell biologist Tom Roberts. For 35 years, Roberts has studied the mechanical and molecular means by which amorphous single cells purposefully propel themselves throughout the body in amoeboid-like fashion, without muscles, bones or brains.

Roberts and his team have found a novel way around unco-operative human cells. In a landmark study led by Roberts and conducted with colleague Katsuya Shimabukuro, they used worm sperm to replicate cell motility in vitro – in this case, on a microscope slide. Doing what no other scientists had ever successfully done before, Shimabukuro disassembled and reconstituted a worm sperm cell, then devised conditions to promote the cell's natural pull-push crawling motions even in the unnatural conditions of a laboratory.

"Understanding how cells crawl is a big deal," Roberts said. "The first line of defence against invading micro-organisms, the remodelling of bones, healing wounds in the skin, and reconnecting of neuronal circuits during regeneration of the nervous system... all depend on the capacity of specialised cells to crawl."

"On the down side, the ability of tumour cells to crawl around is a contributing factor in the metastasis of malignancies. But we believe our achievements in this latest round of basic research could eventually aid in the development of therapies that target cell motility in order to interfere with or block the metastasis of cancer."

● *Source: Florida State University*

ON THE WEB

Sound like a movie you'd watch? Visit www.popularmechanics.co.za and enter to win a double ticket to attend a pre-screening of *Real Steel* in Johannesburg, Durban and Cape Town.

■ HOLLYWOOD FACT vs FICTION



Rock 'em, sock 'em

HUGH JACKMAN WONDERS IF FUTURE ROBOTS WILL BE ABLE TO BOX THE WAY THEY DO IN HIS CURRENT MOVIE.

<< BOUND TO BE A HIT

Hugh Jackman in the corner with one of his robot boxers in *Real Steel*.

When **POPULAR MECHANICS** visited the set of *Real Steel* – which takes place in a not-too-distant future where robots face off in the boxing ring – leading man Hugh Jackman asked us, “Will robots really be this advanced in 10 years?” We had a partial answer: the film touches on current and developing robot technologies, but bot boxing would require major advances. Still, Jackman’s curiosity prompted us to dig deeper.

Real Steel’s bots fight with human motor skills and even adapt to their opponents’ moves. According to Drew Bagnell, an associate professor at Carnegie Mellon University’s Robotics Institute, researchers are currently studying robotic balance and fluid movement. The University of Michigan’s biped robot MABEL, for example, can run at about 11 km/h and keep its balance while reacting to its environment.

In *Real Steel*, bot boxer Atom learns to spar by mimicking Jackman’s movements. Something similar is occurring in real life. “We got the best performance out of DARPA’s Crusher robot when a human showed it how to drive,” Bagnell says. “It learned to associate sensor readings with things people avoid and things they drive over; that made it able to drive in places it had never visited before. What happens in *Real Steel* is (easier), because the robot is mimicking simple trajectories.”

Another bot, Zeus, studies the fight styles of its foes and figures out how to defeat them, giving Zeus the advantage. What *Real Steel* gets wrong, Bagnell says, is the remote control. Operators in the film use fight decks to pilot the robots, but most state-of-the-art bots are autonomous. “People give them a task, and they figure out how to do it,” he says. “For a boxing robot, you’d need some level of autonomy – a person couldn’t control every joint at once.” Although sparring robots may seem far-fetched now, “10 years is a long time”, says Bagnell. “Nothing in the film seems wildly unreasonable.”

So, there’s your answer, Hugh. (You don’t mind if we call you Hugh, do you?) We’re glad you asked. – ERIN MCCARTHY

PM

WHY PAY THROUGH YOUR NECK?

Personally, I love having money in my wallet.
Love it, love it, love it.



Tall Horse

A different take on wine.

PM Lab Test



Mac vs PC

The desktop operating system may soon be dead. Apple's latest release of OS X, Lion, shows a heavy influence from iOS, the operating system found on iPhones and iPads. Likewise, the upcoming Windows 8 OS, expected in 2012, is inspired by smartphones. Yet the personal computer itself is far from gone. Sales may be down, and tablets may be hot, but there are still hundreds of millions of laptops and desktops that serve as the primary window through which the world works and plays. And many people feel their computer choices define them – allegiance to an OS can be as passionate as loyalty to a sports team or a political party. Well, it's time to stop the bickering and cut through the rhetoric and marketing once and

for all. We purchased two near-identically specced laptops: one with Windows 7 and another with Mac OS X Lion – and subjected them to a brutal battery of tests to see which UI has the higher IQ.

The contenders

Model: Apple MacBook Pro

Processor: Intel Core i5, 2.3 GHz
Graphics: Intel HD 3000
RAM: 4 GB DDR3
Hard drive: 320 GB, 5 400 r/min
Screen: 33 cm, 1 280 x 800 pixels
Battery life: 7 hours
Ports: 2 x USB, Ethernet, Thunderbolt, FireWire, SD
Operating system: Mac OS 10.7 Lion

R11 700



Model: HP Pavilion DM4

Processor: Intel Core i5, 2.3 GHz
Graphics: Intel HD 3000
RAM: 4 GB DDR3
Hard drive: 500 GB, 5 400 r/min
Screen: 36 cm, 1 366 x 768 pixels
Battery life: 6.75 hours
Ports: 3 x USB, Ethernet, HDMI, VGA, SD
Operating system: Microsoft Windows 7, Service Pack 1

R8 200



Our test results

Mac	PC
Processor speed score	
6 429	6 524
Graphics Speed Test (fps)	
12,64	9,7
Gaming (fps)	
31,6	32,8
Six-app simultaneous launch (sec)	
10,5	11,5
Video conversion (sec)	
196	220
YouTube HD CPU use	
59%	5%
File compression (sec)	
19	95
Wake from sleep (sec)	
4,48	5,12

Yellow indicates winner

HOW WE TESTED

Processor tests were conducted with benchmark software Geekbench 2.1.13, which assigned each machine a performance score. The Cinebench 11.5 benchmark was used to test raw graphics capability in frames per second (fps). Our gaming test relied on Valve's

Portal 2 run at high-quality settings. For video conversion, we used HandBrake 0.9.5 to convert a 720p H.264 video to a mobile size. App-launch stress testing used Microsoft Office (Word and Excel), Adobe Photoshop, Mozilla Firefox, Google Chrome and HandBrake.

We played a YouTube HD video to see how severely Flash video strained each system's processor. For the compression test, we compressed 786 megabytes of files using the operating systems' built-in archive functions.

User experience

We gave our machines to everyday users. Here's what they thought.

Business traveller

"The Mac's navigation is cleaner and more organised. However, it doesn't automatically maximise apps, which adds an extra step. I prefer the PC's separate left/right click buttons, and without guidance I never would have known about OS X's finger gestures. Both machines, however, would suit my needs."



Teacher

"The PC has a bigger screen at the same weight. Navigation in both OSs is easy if you know what to do, but neither is intuitive. Aero Peek in Windows is great, as are Jump List shortcuts in the Start menu. I've been a Mac user forever, but I think I'll switch to a PC for my next computer."



Know your interface

Mac: The first version of OS X (10.0), called Cheetah, launched a decade ago, and much of it remains in Mac OS X Lion (10.7), including the **Dock**, an applications launcher. But there have been significant changes.

Mission Control provides a bird's-eye view of the OS, where users can see and organise open applications and switch between separate desktops, or Spaces. Other features have been carried over from smartphones: apps are downloaded from the App Store, and programs are suspended rather than fully closed, so that saving files isn't necessary. Smartphone and tablet users will easily grasp the new multitouch gestures, but it can be hard to tell where the "home" of the OS is. Is it Mission Control? The Dock? The iOS-style Launchpad?



PC: Windows' greatest strength is familiarity. Its core navigation and application-launching tools, the **Start menu and taskbar**, were introduced in Windows 95; these features, along with much of the logic of the menus and keyboard shortcuts, have changed little since, meaning that anyone who has used Windows in the past 15 years will feel at home in Windows 7. Yet Microsoft has done much to improve the Start menu/taskbar concept over the years, adding instant menu and file searching, visual application previews and a view called **Aero Peek**, which lets users find windows by hovering the cursor over the taskbar.

Where some users will find comfort and consistency, others will find staleness. Windows 7 is a refinement, not a reimagining.



Animator

"Windows feels clunky – it reminds me of my old computer, but at least I know where stuff is. Mac hardware and software feel more modern, but I don't see the point of some of the gestures."

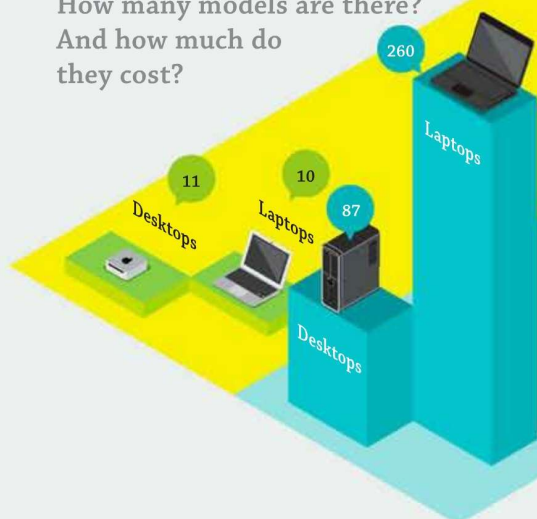


Gamer

"Both Web browsers are terrible – download a new one. Seems like there's more to set up with a PC. The HP's hardware feels cheaper, but I like the roundness and slick feeling; the Mac finish is gritty, and edges are sharp. Both are fine for multimedia, but for gaming, PC wins."

Hardware

How do buyers' options stack up?
How many models are there?
And how much do they cost?



Mac: Apple's hardware is attractively designed and well built, but options are limited and expensive. Macs also have certain hardware limitations: no Blu-ray drives, no HDMI ports in laptops and no removable batteries. Many laptops have flash storage, which is fast, but limited in capacity.

MAC: STARTING PRICE

Laptop: R9 300
Desktop: R12 000

PC: Microsoft lets anyone make Windows PCs, which means there are plenty of options in specifications, designs and prices. A vast array of ports and accessories is available. Hardware quality runs the gamut from top-notch to poor; hardware prices, from sky-high to bargain-basement.

PC: STARTING PRICE

Laptop: R2 600
Desktop: R2 000

Software

What's included

Mac: OS X Lion comes with a suite of apps, including iTunes (music), iPhoto (photo management), iMovie (movie editing), Mail and Safari (Web browser). Serious document-editing apps are not included.

PC: Windows 7 comes with few apps, but Microsoft offers many of the missing pieces, including e-mail, movie editing and photo management, as free downloads. PC makers often bundle Microsoft Office for free, but also include unwanted bloatware.

What's available

Mac: Today's most popular apps are available on the Mac OS – where there is no Mac version of a Windows app, there is often a quality alternative. Gamers, however, will find little comfort in Mac OS's anaemic game selection.

PC: Windows has a glut of available software, and no central app store. You may always be able to find the app you need, but it could take some work. Thousands of games, from vintage to cutting-edge, are available.

Platform agnostic

No matter which side you're on, you'll end up using a lot of the same apps. Here are some of the must-haves.

Firefox/Chrome: Fast, full-featured Web browsers that are better than either Safari or Internet Explorer.

Microsoft Office/OpenOffice: Office is the de facto productivity suite; OpenOffice is a capable free and open-source alternative.

Dropbox: An online storage locker for your files. Drag and drop files the way you would with a flash drive.

Google Apps: Websites that behave like apps, including Gmail, Google Docs and Google Calendar.

Facebook and Twitter: The most popular social sites don't have a stake in the Mac-versus-PC battle.

LAST WORDS

The battle between platforms is over. In our tests, raw performance was almost identical. Support for third-party software was close to equivalent. Whereas our Mac felt faster by a hair, our PC was cheaper by a mile. Our PC came with a bundle of free software, but our Mac was impervious to viruses. The point is, as tools, these machines are both hugely – and equally – capable. And make no mistake: in 2011, tools are what they are. Smartphones and tablets have stolen our attention and affection away

from laptops and desktops, and they're not giving them back. Besides, Google, Facebook, Twitter and Bing, where we spend so much of our time, are apolitical. So, if you love Macs, stay put. Likewise for PC partisans – Apple's touch-inspired software and sleek hardware are neat, not essential. For everyone else, the choice is simple: save your money and buy a PC. It'll get the job done. And if you're interested in the real future of computing, take that extra cash and pick up an iPad.

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BREAKTHROUGH AWARDS

2011

•••••••••• BY LOGAN WARD AND THE EDITORS OF PM

Innovator
JAMES CAMERON

Brilliant idea
USING TECHNOLOGY
TO OPEN NEW WORLDS
IN SCI-FI AND REAL LIFE

THE VISIONARY

James Cameron with one of the 3D camera rigs he created to film *Avatar*. The director plans to take a version of the rig on a dive to Challenger Deep – nearly 11 000 metres below the surface of the ocean – in a piloted submersible he also helped to engineer.



VIDEO > Visit www.popularmechanics.co.za to watch James Cameron's exclusive interview with Popular Mechanics at the Breakthrough Awards 2011.

WHEN MOST PEOPLE THINK OF JAMES CAMERON, they first think of his movies: *Aliens*, *Titanic*, *Avatar*, *The Terminator*. Then they might reflect on how his films have pushed major technological advances in the entertainment industry, from the state-of-the-art visual effects that created the water tentacle in *The Abyss* to the high-tech SimulCam system used to film *Avatar*.

But for Cameron, Hollywood is just the beginning. His innovations are also expanding human knowledge by exploring new frontiers. "Exploring is, in many ways, my first love," the director says. He has led an expedition to probe the wreck of the German battleship *Bismarck* and helped design 3D cameras for Nasa's next Mars rover.

"We let Jim shoot pictures with our cameras in Mars orbit," says Michael Ravine, advanced projects manager at Malin Space Science Systems. "When I brought him the 3,6 m-long prints, he halted a meeting and came out to sweep the floor so we had a big enough area to unroll them. He was asking questions about collapsed lava tubes while all these movie folks stood around, wondering what was going on."

Cameron isn't a scientist – "I think of myself more as a science groupie," he says – but there's no telling how many have been inspired by his work. POPULAR MECHANICS correspondent Anne Thompson spoke to Cameron about his plans to dive to Challenger Deep, the real obstacle to colonising Mars and how humanity should grapple with its greatest challenge.

POPULAR MECHANICS: Next year you plan to dive to the deepest known point in the ocean in a sub that you've helped design. Why?

JAMES CAMERON: I believe in exploration. These trenches, which are deeper than 6 000 metres, have never been explored. We don't know what's there. Space exploration is really the product of governments. Most individuals can't afford to explore space. For private exploration, we're really bound to the Earth, and the last great frontier is the Hadal trenches.

Footage for both Titanic and the documentary Ghosts of the Abyss came from ROVs. How have your undersea vehicles evolved over time? In 1998, we started to engineer these small robotic vehicles that were designed to go inside shipwrecks. We decided to use syntactic foam – the only flotation system that works at extreme depths – structurally on the robotic vehicle, which had never been done before. Now we're building our 7 m-long piloted submersible, the *Deep Challenger*, entirely out of syntactic foam – except for the pressure hull, which is the sphere that we all sit inside.

What are the challenges of engineering to withstand deep-sea environments?

At 11 000 metres, you've got 16 000 pounds per square inch of pressure. That translates to tens of millions of pounds distributed over the surface of the sub's pressure sphere. If your pressure port fails, your sub is going

to implode. If your penetrator fails, a jet of high-pressure water will enter the sub and cut everything in half. These are the risks that you have to engineer against. But they're also givens from the beginning of every project.

Were there any times on a dive when you were in real danger?

There have been white-knuckle moments – complete power failures, where we've had to use emergency ballast systems to get back. And that gives you an appreciation of the layers of technology that go into these machines to make them safe. I've done 75 submersible dives since 1995, and, yeah, your life is at risk anytime you go into a hostile environment like that. But you trust the engineering.

You were also very involved in developing a 3D camera for the Mars rover Curiosity before Nasa's budgetary concerns got in the way.

I'm a very minor player in development of the Mastcam, the eyes of the rover that will launch later this year. The camera was originally conceived to be 3D and have two zoom lenses, (but Nasa) decided to go with fixed-focal-length lenses in two different focal lengths, meaning we can't do 3D.

You used 3D in Avatar to create a completely immersive world. What's the value of sending 3D cameras into



unexplored places like space and the deep sea?

Evolution has made 3D the standard method for viewing the world. There's a heightened sense of being physically present, so people will have a greater appreciation of exploration in general and what is specifically being learned – whether it's on the surface of Mars or at the bottom of the ocean.

Sending cameras is one thing, but do you have any ambitions to go to space yourself?

Absolutely. I was going to go up on the Russian Soyuz system. Elon Musk's Dragon spacecraft (see elsewhere in this article) will have the ability to send seven people into low Earth orbit – and none too soon. The space shuttle was just sucking up a lot of money and going nowhere fast, literally – going 27 000 km/h to stay in orbit. That's like Columbus going to Queen Isabella and saying, "I'm going to explore a new continent. But first I'm going to sit offshore for 30 years and study the problem of people living on small ships."

We've learned a lot about Mars in the past decade. What will it take to fully explore it?

I think it'll be like ocean exploration: a mixture of humans and robotics. We could put the most capable rover on Mars, but there's still as much as a 40-minute lag – so if we tried to tell it to avoid running off a cliff, it would be lying at the bottom in pieces for 40 minutes by the time it got the signal. If you want to get a lot of work done, you've got to put a human there.

What obstacles do we face in actually getting people to Mars?

We could use chemical rockets to send people to Mars. That's not the issue – it's living on the surface. The



only way to tackle that problem is to tackle that problem, not talk about it. This country has the potential to be resting on its laurels so long that it loses the capability to do the kinds of things that we pride ourselves on being able to do. No human has been outside low Earth orbit in 40 years. That's crazy!

What is the role of science-fiction filmmaking in inspiring people to think boldly?

Fantasy and imagination have driven the filmmaking process, which has driven technology. And I know from working in the sciences – especially space science and astronomy – that every one of these scientists was a science-fiction fan when they were a kid. It was an outlet for their imagination and their sense of what was possible.

POPULAR MECHANICS is going to be 110 years old next year. Where will humanity be 110 years from now?

We're facing arguably the most challenging century in human history. We have to get our act together and learn to co-operate between nations to solve global-scale problems. This is the turning point where we've exceeded, or will shortly exceed, Earth's ability to support us. And we're going to have to change our thinking. We have to be more organised and self-sacrificing and less contentious, or we're not going to make it.

What do you think we need to do to make these changes happen?

We need to start trusting science a whole lot more. We love it when science gives us something we want, like the semi-conductors in our brand-new iPad. But we don't trust science when it's a message we don't want to hear, like we need to reduce our consumption of resources. There were warnings in science fiction, whose job has always been to imagine the future – whether an exciting future of shiny technology or a dystopian one. And now there are very real warnings from the science community, but we're not taking them seriously. The danger is very real. We are racing toward a cliff with the top down and the radio playing. We've got to wake up.

You're passionate about so many of the topics POPULAR MECHANICS covers. What does winning this award mean to you?

The magazine is a mixture of science, engineering and backyard tinkering. I love that, because I like to sit at that particular nexus myself. This award symbolises that I've managed to pull it off – to do something of value in those areas.



1: With Arnold Schwarzenegger on the set of *Terminator 2: Judgment Day* in 1991.

2: Cameron in 1995, before an expedition to the *Titanic* wreck in a Mir sub.

3: Inspecting an engineering model of the 3D Mastcam he helped develop for Nasa's next Mars rover, *Curiosity*.

4: With other members of the X Prize Foundation board of trustees experiencing zero gravity on G-Force One, a modified Boeing 727-200.

5: Cameron filming *The Abyss* in an unused nuclear power plant containment tank filled with 28 million litres of water.

NEXT-GEN
AWARD



Innovators

WEST PHILLY HYBRID X TEAM
 SIMON HAUGER, FACULTY ADVISER

Brilliant idea

A 1,5 LITRES/100 KM E-CAR — AND AN AFTER-SCHOOL PROGRAMME FOR HANDS-ON EDUCATION

A STUDENT SUPERCAR

OF THE 111 TEAMS that competed for the R70 million purse in last year's Progressive Insurance Automotive X Prize, only one was from a high school – West Philadelphia, where 85 per cent of students are economically disadvantaged. West Philly entered two vehicles – a Factory Five GTM biodiesel hybrid kit car (above) and a converted Ford Focus petrol plug-in hybrid – and made it to the semi-finals with both. "We were going up against teams that had

dozens of engineers, and we had 15 students, a couple of teachers and a dream," says adviser Simon Hauger, a teacher in the school's Academy of Automotive and Mechanical Engineering. "One of the marvellous things about teenagers is they're not daunted by that." After its impressive X Prize performance, West Philly won the Green Grand Prix in Watkins Glen, New York, last April, when its GTM achieved the equivalent of 1,5 litres/100 km over 160 km. "I always liked fast, gas-

guzzling race cars, so when I first heard the club was named the Hybrid X Team, I wasn't so sure, but I gave it a try," says team captain Stefon Gonzalez. "It definitely broadened my horizons, not just with cars but with things like public speaking, fundraising and networking." The after-school programme also helped the high school senior (and two other teammates) land a public-transit internship with the Southeastern Pennsylvania Transportation Authority. "I call it the light-switch effect," Hauger says. "This work truly enlarges the students' vision for what

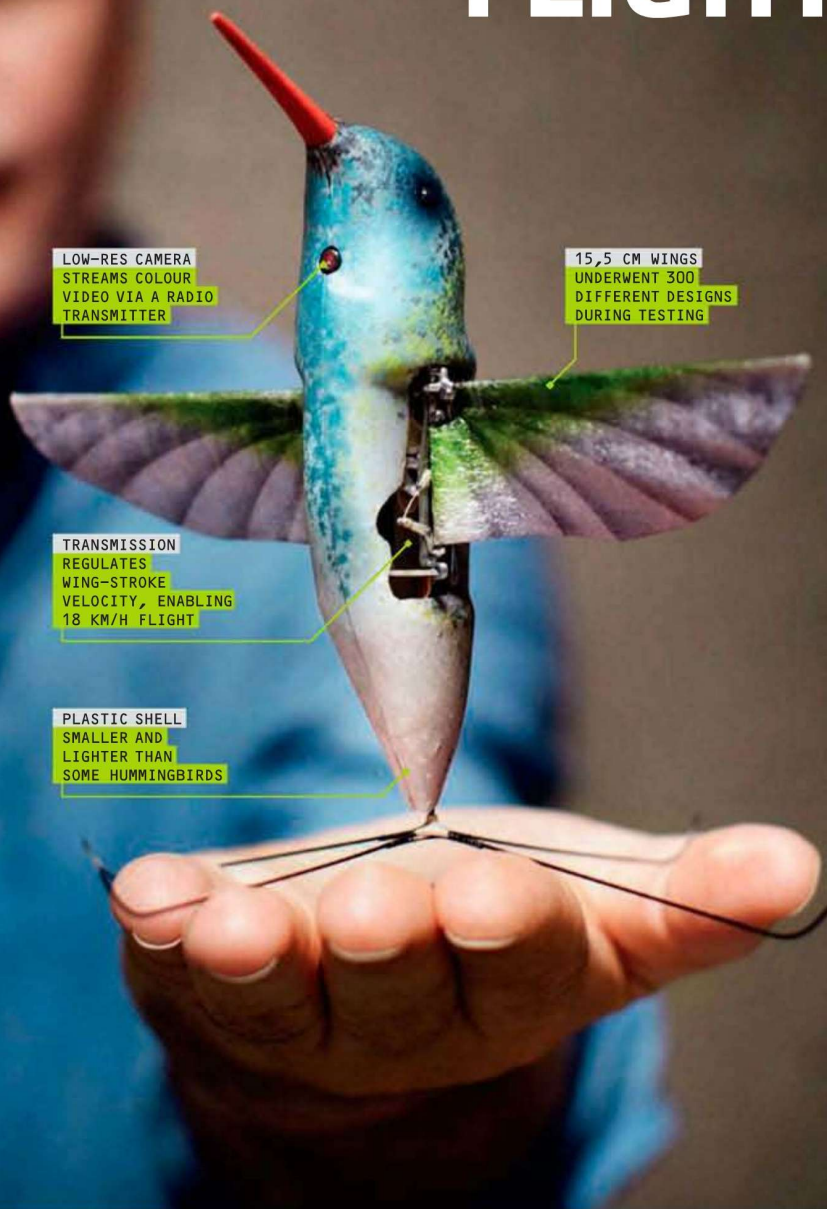
they're capable of doing. We don't put them in a row of desks and lecture about fuel efficiency, bio-fuels or aerodynamics. We say, 'Let's solve this problem together'." The students so impressed Edison2 founder and Automotive X Prize champion Oliver Kuttner that he asked them to build an electric version of his Very Light Car (VLC). The team hopes to operate a non-profit after-school project that employs students to make and sell the EVLC kit car. "When they're done, they will have the world's most efficient electric car by a leap," Kuttner says.



VIDEO > Visit www.popularmechanics.co.za to view a video showing the Factory Five GTM being tuned.

Clockwise from left: Jeffrey Johnson, Stefon Gonzalez, Brandon Ford, Shamere Palmer, Adam Mitchell, Sydney Dickerson, Azeem Hill, Morris Bailey and Ciera Williams.

REIMAGINING FLIGHT



LOW-RES CAMERA
STREAMS COLOUR
VIDEO VIA A RADIO
TRANSMITTER

15,5 CM WINGS
UNDERWENT 300
DIFFERENT DESIGNS
DURING TESTING

TRANSMISSION
REGULATES
WING-STROKE
VELOCITY, ENABLING
18 KM/H FLIGHT

PLASTIC SHELL
SMALLER AND
LIGHTER THAN
SOME HUMMINGBIRDS

THE ASSIGNMENT WAS daunting: build a remote-controlled aerial vehicle; make it tiny but highly manoeuvrable; install a camera so that pilots can navigate it into buildings using only a live video stream; and model the craft after a real bird. "There could be no thrusters, no propellers," says Todd Hylton, who oversaw the project for DARPA's Nano Air Vehicle programme – just two wings that flap.

Matt Keennon, an engineer for California-based AeroVironment, led the team that met this challenge, building the first-ever robotic hummingbird. "As far as we know, this is a new form of man-made flight," says the lifelong model-aircraft fanatic. Altering wing speed changes thrust, while slight modulations in wing angle send the craft zipping off in any direction. It can also hover in place against gusting wind. The team custom-built most of the aircraft by hand using machine tools, microscopes and an old-school Swiss watchmaker's lathe to fashion parts, including tiny flanged pulleys in the flapping-wing transmission. The whole craft, including motors, battery, communication systems and video camera, weighs less than an AA battery.

The Pentagon hopes the Nano Hummingbird will usher in a new class of aerial surveillance vehicles capable of identifying targets, collecting intel and locating hostages indoors, not just on the battlefield. Law enforcement agencies might also use the drone to gather evidence – during stand-offs or drug raids, for instance – and for search-and-rescue missions. During last year's nuclear meltdown in Japan, says Hylton, "it would have been great to have a small vehicle to fly into the reactors to see what was going on before sending in humans."

Matt Keennon holding the Nano Hummingbird, which can hover and fly in three axes of motion using only two flapping wings.



> Visit www.popularmechanics.co.za to catch the Nano Hummingbird in action.

Innovators

V REGGIE EDGERTON & YURY GERASIMENKO UCLA
SUSAN HARKEMA UNIVERSITY OF LOUISVILLE
JOEL BURDICK CALTECH ROB SUMMERS

Brilliant idea

AN ELECTRIC THERAPY THAT
STIMULATES SPINAL NERVES,
ALLOWING THE PARALYSED TO WALK

OVERCOMING PARALYSIS

A HIT-AND-RUN ACCIDENT IN 2006 left Rob Summers paralysed from the chest down, shattering the college baseball player's Major League prospects. But his injury – and his athlete's dedication – made him the ideal candidate for a one-of-a-kind experiment led by a scientific dream team.

UCLA researchers V Reggie Edgerton and Yuri Gerasimenko had been studying the effects of electrical stimulation on the spinal cord in animals for decades. To test their theories in a human, they teamed with Susan Harkema, rehabilitation director at the Kentucky Spinal Cord Injury Research Centre, and Joel Burdick, a CalTech bioengineer.

After preparing Summers with two years of physical therapy, the scientists implanted an electrode array over his lumbosacral spine, enabling them to send pulses of electricity directly to his spinal cord.

This epidural stimulation amplifies motor commands to the injured area. The team believes it also activates local circuits of the spinal cord that can produce movement but that are not directly controlled by the brain. The spinal cord is "smart, and it's plastic", Edgerton says. "That is, it can change. It can even learn motor tasks."

The bursts of electricity, combined with the repetitious movement of the locomotor training, may awaken neural circuits that send impulses to specific body parts. "This can happen without any input from the brain," he says.

Summers, one of more than 1,3 million Americans who live with spinal cord injuries, recovered unprecedented voluntary movement for someone with complete paralysis. "The third day they

turned it on, I stood independently after not moving anything in four years," he says. With stimulation, Summers can now bear his own weight for 4 to 25 minutes, move his toes, ankles, knees and hips on command and take a few steps on a treadmill. According to research published in *The Lancet*, he also resumed some bodily functions including the ability to sweat – which enabled him to work as a guest pitching coach at a baseball camp in Florida.



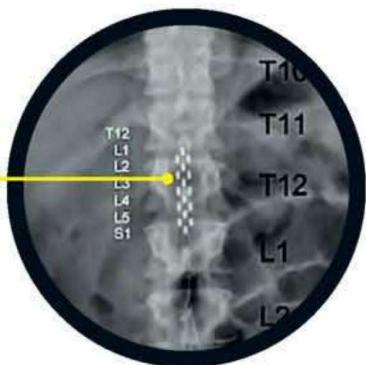
From left: V Reggie Edgerton, Susan Harkema, Rob Summers, Yuri Gerasimenko and Joel Burdick. Here, Summers supports his body weight with his arms.

Picture by Misha Gravenor

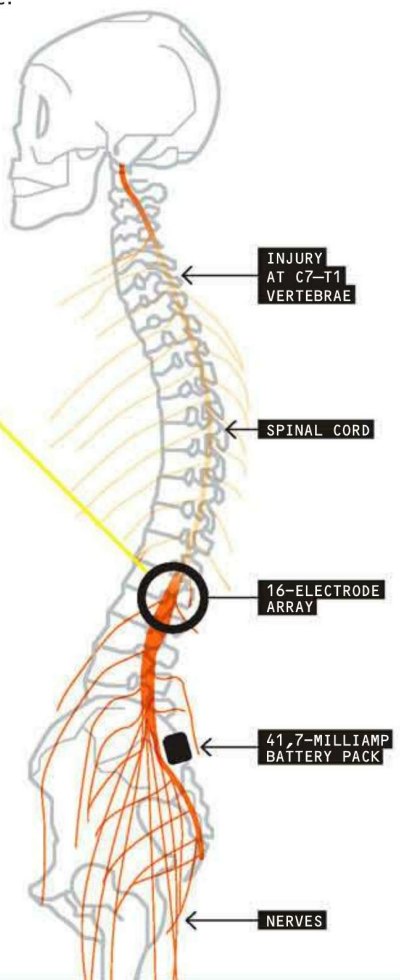


VIDEO > Visit www.popularmechanics.co.za to watch Summers stand and take steps thanks to electrodes implanted near his spine.

The electrode array was implanted at Summers' T12 vertebra, stimulating his L1-S1 spinal cord segments.



"Prior to that, my body couldn't handle the heat," he says. While the scientists, who have approval for four more human subjects, are cautiously optimistic, researchers from the University of Zurich were less reserved in a commentary that appeared in the same issue of *The Lancet*: "We are entering a new era when the time has come for spinal cord-injured patients to move."



VIDEO > Visit www.popularmechanics.co.za to watch Osorb swelling in real-time up to 8 times its original size.

A flexible web of glass nanoparticles makes up each piece of Osorb. When it comes in contact with pollutants, the web opens up to encapsulate them, causing the Osorb to swell (inset).



Innovator

PAUL EDMISTON COLLEGE OF WOOSTER, ABSMATERIALS

Brilliant idea

A POWDER THAT STRIPS NASTY CHEMICALS FROM WATER, OVER AND OVER AGAIN

MATERIALS SCIENCE

TOXIC-WATER SPONGE

CHEMIST Paul Edmiston has plenty of data to prove how well Osorb, a glass substance, soaks up petroleum, solvents and other organic contaminants. But he's most convincing when he mixes motor oil with water, adds Osorb, filters off the swollen powder and drinks the remaining liquid. "It works like a nanomechanical sponge," he says. "I've done trace analysis, and the water's totally clean."

A graduate student of Edmiston's stumbled upon the material while experimenting with molecules for a bomb-detection device. After she added acetone to a beaker of silicas, they ballooned to eight times their normal size. She went straight to Edmiston, asking, "Did I mess up?"

Much to the contrary: the silicas, Edmiston realised, are hydrophobic, so they ignore water but grab both polar compounds (such as acetone) and non-polar ones (such as

octane) out of solution. The contaminants can be released for disposal or recycling by squeezing the nanomechanical sponge – that is, by applying heat. The swellable glass can be re-used more than 100 times.

Osorb could clean up a number of intractable environmental problems, from industrial accidents to the billions of litres of wastewater produced by the boom in natural gas fracking (hydraulic fracturing). In a pilot test at a well in Ohio, a prototype system treated 227 litres of water per minute, slashing its petroleum content from 227 milligrams per litre to 0,1 mg per litre.

A metal catalyst in a new version of Osorb goes one step further, breaking down contaminants to environmentally benign molecules. Stephen Spoonamore, Edmiston's partner in a start-up called ABSMaterials, describes it as "a catalytic converter that works on liquids instead of gases".

Picture by Ben Goldstein/Diagram by Dogo

Innovators

SPIRIT AND OPPORTUNITY

ENGINEERING TEAM LED BY: STEVEN SOUYRES CORNELL UNIVERSITY
JOHN CALLAS, RICHARD COOK, PETER THEISINGER NASA JET PROPULSION LAB

Brilliant idea

ROBUST ROBOTIC SURROGATES
FOR HUMANS ON MARS

MECHANICAL
LIFETIME
ACHIEVEMENT
AWARD

MARS ROVERS

SPEED WHEN ENTERING MARS ATMOSPHERE:

20 000 KM/H

LENGTH: 1,6 M

WIDTH: 2,3 M

HEIGHT: 1,5 M

WEIGHT: 174 KG

17 times heavier than Pathfinder

TOP LAND SPEED: AVERAGE LAND SPEED:

5 1 CM/SEC CM/SEC

OPERATING TEMPERATURE:

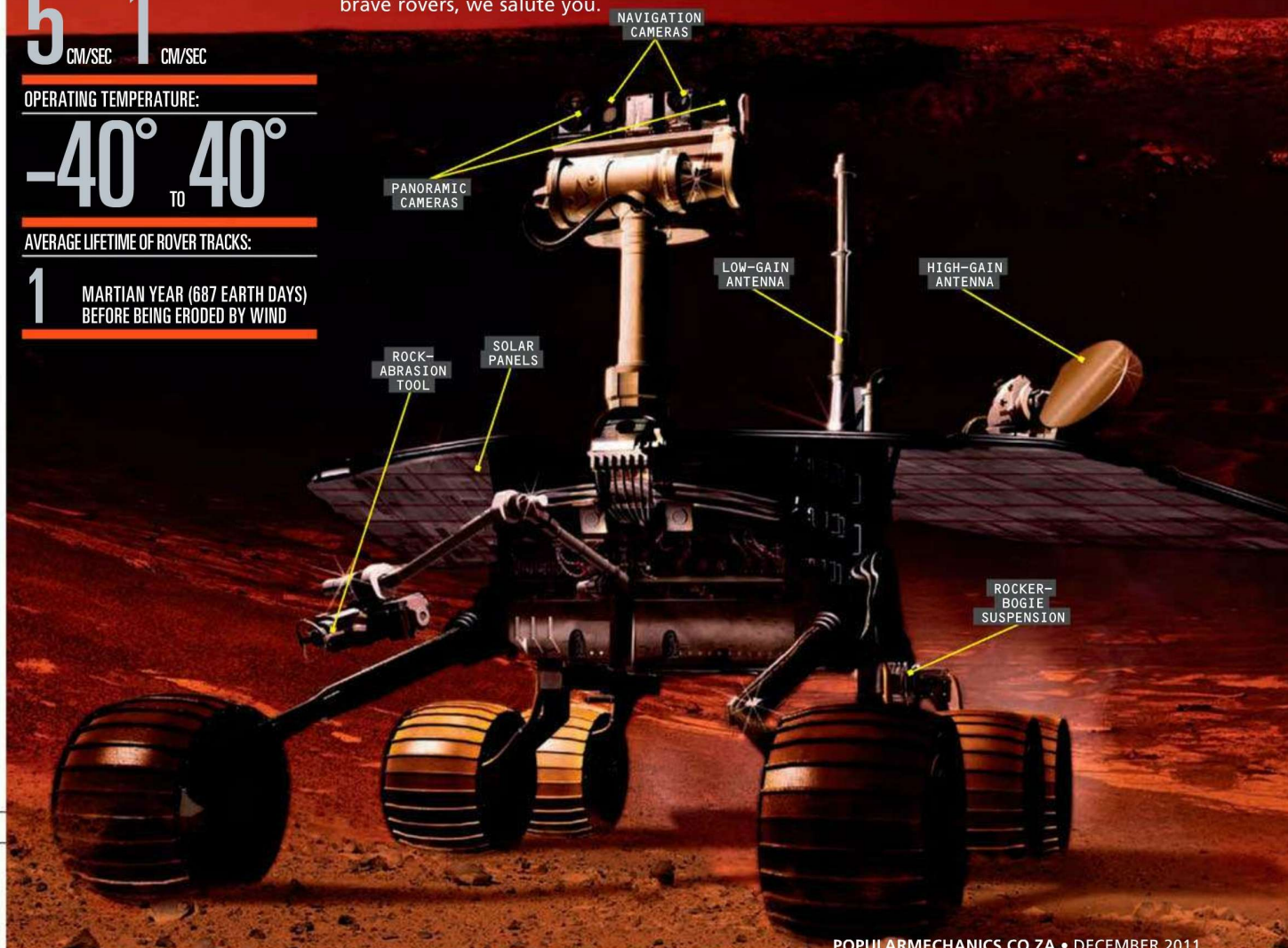
-40° TO 40°

AVERAGE LIFETIME OF ROVER TRACKS:

1 MARTIAN YEAR (687 EARTH DAYS)
BEFORE BEING ERODED BY WIND

FOR SIX-WHEELED, 200-kg mechanical geologists, Mars rovers *Spirit* and *Opportunity* have really turned on the charm, working their way into the hearts of an admiring public – and, most powerfully, those of their engineers. “We just couldn’t be prouder of those little rovers,” says NASA’s deputy administrator, Lori Garver. After landing on Mars in 2004, each rover was meant to operate for 92 days and travel about 1,2 kilometres. Nearly seven years and 30 km later, *Opportunity* still motors on. *Spirit* performed a feat of Martian mountaineering before finally running out of power on the darker, harsher side of the planet last year. To observers such as Daniel Wilson, author of *Robocalypse* and a PM adviser, “They’re a great example of the resilience of robots and the ingenuity of humankind.”

If the rovers’ stamina wildly exceeded expectations, so have their discoveries: picture-postcard images from the surface of Mars, evidence that the planet once held water, footage of dust devils that offers insights into Martian wind. They also inspired the next generation of space explorers. This November, a new vehicle named *Curiosity* will be sent to the Red Planet to continue Nasa’s Mars Exploration Programme, which began in 1976 with the two Viking landers. It will drill into soil and fire lasers at rocks, analyse mineral samples and search for life’s carbon-based building blocks – work made possible by its intrepid twin predecessors. As John Callas wrote in a heartfelt goodbye to *Spirit*: “She has also given us a great intangible. Mars is no longer a strange, distant and unknown place. Mars is now our neighbourhood.” For all that, brave rovers, we salute you.



**VIDEO**

> During Opportunity's three-year trek on Mars, rover planners captured a horizon photograph at the end of each drive. Visit www.popularmechanics.co.za to watch a video compilation of these end-of-drive images...

SPIRIT

LAUNCH DATE: 06/10/03

FLIGHT DISTANCE:

490 000 000 KM

LANDED:

01/04/04

LONGEST ONE-DAY ADVANCE: 124 M

SHARPEST INCLINE SCALED: 30,2 DEGREES

IMAGES RETURNED:

124 000**1: GUSEV CRATER**

Spirit touches down as planned in the 153 km diameter Gusev crater, which scientists think may once have held an ancient lake.

2: SUMMIT OF HUSBAND HILL**08/21/05**

TOTAL DISTANCE TRAVELLED: 5 KM

In pursuit of different rock types, *Spirit* climbs a hill roughly the height of the Statue of Liberty – becoming the first explorer ever to scale another planet's summit.

3: HOME PLATE**02/21/06**

TOTAL DISTANCE TRAVELLED: 6,6 KM

Spirit finds clues that an explosive volcano formed this rocky outcrop – and that water may have played a role in its creation.

4: TROY**05/01/09**

TOTAL DISTANCE TRAVELLED: 7,7 KM

While driving backward, dragging a disabled front wheel, *Spirit* becomes mired in soft soil. The rover studies it until losing contact with Nasa in March 2010.

OPPORTUNITY

LAUNCH DATE: 07/07/03

FLIGHT DISTANCE:

455 000 000 KM

LANDED:

01/25/04

LONGEST ONE-DAY ADVANCE: 220 M

SHARPEST INCLINE SCALED: 31,2 DEGREES

IMAGES RETURNED:

155 671**1: EAGLE CRATER**

After landing inadvertently in this crater on Meridiani Planum, *Opportunity* uses its rock-grinding tool. It discovers hematite, which forms inside deposits soaked with groundwater.

2: VICTORIA CRATER**09/27/06**

TOTAL DISTANCE TRAVELLED: 9,3 KM

Opportunity explores inside this stadium-size crater, finding that water has come and gone there several times in the past.

3: BLOCK ISLAND**07/28/09**

TOTAL DISTANCE TRAVELLED: 17,2 KM

The rover finds and analyses this watermelon-size, iron-nickel meteorite, which holds clues to the history of the Martian climate.

4: ENDEAVOUR CRATER**08/09/11**

TOTAL DISTANCE TRAVELLED: 33,5 KM

Opportunity reaches Spirit Point on the rim of this 22-km-wide crater – home to exposed rock outcroppings older than any the rover has yet examined.



Illustration by Alexander van Daalen





Innovator
PETER HOFBAUER
 ECOMOTORS

Brilliant idea
 A HIGH-POWER, LOW-EMISSIONS
 INTERNAL COMBUSTION ENGINE

A BETTER ENGINE

TURBOCHARGER

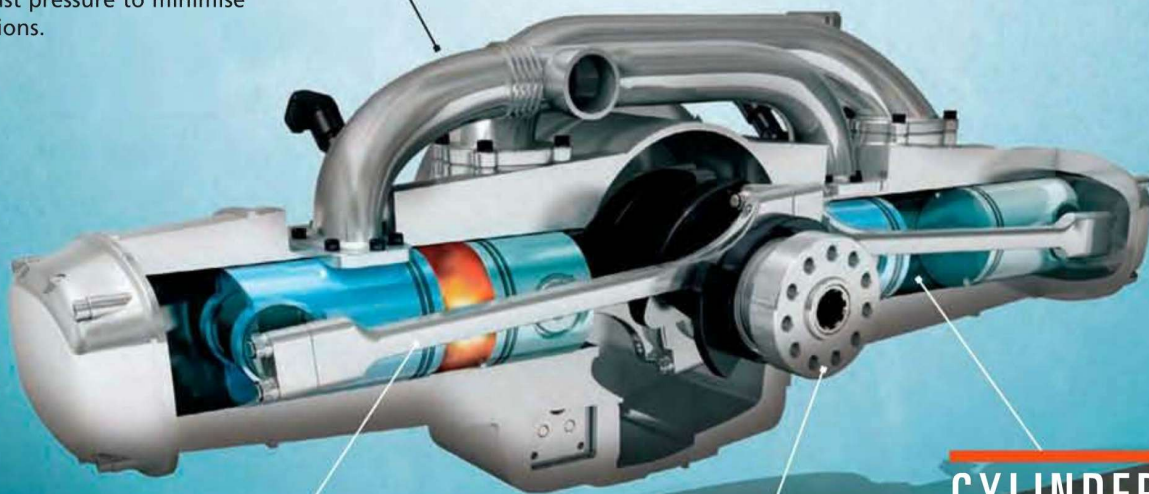
An electric motor mounted to the blower's shaft quickly spools the compressor for a fast boost; in reverse, it generates electricity off the exhaust flow. Plus, it manages exhaust pressure to minimise emissions.

RELATIVELY SIMPLE and lightweight, two-stroke engines (found in chain saws and outboard motors) would be great in cars and trucks, if they weren't so dirty. "I probably spent R350 million of GM's money proving two-strokes don't work in cars," says General Motors veteran Don Runkle. The Opposed-Piston, Opposed-Cylinder (OPOC) engine developed by EcoMotors' Peter Hofbauer changed Runkle's mind so thoroughly that he became the company's CEO.

As in other flat engines (sometimes called boxer engines for the way their pistons resemble two fighters trading jabs), OPOC's pistons move horizontally. Hofbauer's aha! moment came one day when the former Volkswagen engineer was pondering the shortcomings of VW's boxer engine.

"I thought, my God, if you just replace the cylinder head with a moving piston and cylinder ports, it might be less complicated." It is – by a long shot. The engine requires less than half the parts of a similar four-stroke engine and is 30 per cent lighter. The net result, says Hofbauer, is a 15 to 50 per cent increase in energy efficiency, depending on the configuration. And thanks to its unique architecture and several key innovations, the OPOC releases far fewer emissions than a typical two-stroke.

With a 179 kW diesel prototype, EcoMotors is focused now on the truck market; last February, the company signed a licensing agreement with Navistar. "When the economy has recovered, the world will add 85 million combustion engines for cars and light trucks," Hofbauer says. "If we can offer an engine that is efficient and competitive in production costs, it will be a success."



STEEL CONNECTING RODS

Long steel connecting rods join the outer pistons to the crankshaft. With two pistons working off one combustion event, the engine behaves as though it has a long stroke – utilising more of the available energy and increasing efficiency. Yet the crankshaft remains compact and therefore lighter.

CRANKSHAFT

The engine is modular, and the crankshaft of the cylinder pairs can be connected by a clutch. For highway cruising, unneeded cylinders can simply be idled and then engaged again for passing.

CYLINDER

Gases flow in and out of the cylinder via ports in the walls, saving the complexity and weight of cylinder heads. The design of the intake and exhaust systems and combustion chamber keeps excess unburned fuel from exiting the exhaust port, reducing emissions.

**Innovators**

JULIANA BLUM, LAURA NIKLASON, SHANNON DAHL
HUMACYTE

Brilliant idea

OFF-THE-SHELF BLOOD VESSELS
COMPATIBLE WITH ANYONE

READY-MADE BLOOD VESSELS

WHILE TRAINING in an intensive-care unit during medical school, Laura Niklason got a graphic view of a persistent problem. "The surgeons spent a lot of time digging around in the patients' legs or arms looking for veins to replace main arteries," she says. "I thought, there's got to be a better way."

According to the most recent National Hospital Discharge Survey, doctors in the US performed 408 000 coronary artery bypass procedures in 2007, all of which required vascular grafts. And more than half of the 320 000 chronic dialysis patients need blood vessels transplanted into their arms. While tissue

engineers can grow compatible vessels from a patient's own cells, the wait time can be more than six months.

Niklason, along with colleagues Juliana Blum and Shannon Dahl, decided the solution should be at a surgeon's fingertips: their company, Humacyte, was the first to make blood vessels that can be stored for future use. To grow these, the researchers seed human smooth-muscle cells onto tubular scaffolds made from a biodegradable polymer. The cells produce collagen and other molecules that form a matrix as the scaffold disintegrates. Using detergent, the researchers scrub away the muscle cells, leaving

non-immunogenic vessels behind – meaning they won't be rejected by an unrelated patient's body. "Think of (the vessel wall) as a sponge," Dahl says. "It has holes that are filled with cells. Wash them away and you're left with something you can still hold on to."

The vessels retained their strength and elasticity after a year of refrigerated storage in a saline solution, according to a study published in February's *Science Translational Medicine*. They were then grafted into animals, where, after six months, they showed no signs of fibrosis or thickening of the vessel walls.

"Since vascular disease is

really the number one cause of morbidity and mortality in the Western world, a way to replace diseased arteries will have huge impact, I hope, over the long term," Niklason says, "particularly with the problem of obesity."

Humacyte hopes to begin human trials overseas in 2012; meanwhile, the team is already thinking beyond blood vessels. The same technique could be used to grow other simple tissues, such as ligaments and cartilage, that are structurally important. Eventually, they think, labs will grow organs with complex functions – making more transplants off-the-shelf.

From left: Humacyte business operations director Juliana Blum, CSO Laura Niklason and scientific operations director Shannon Dahl.

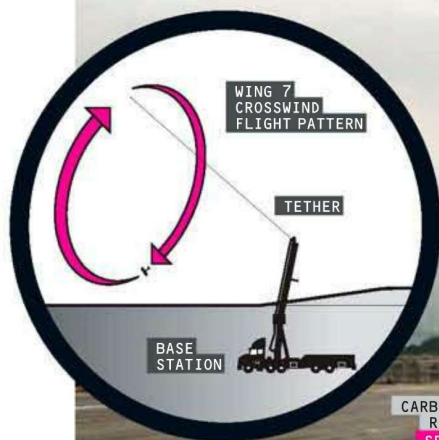
Innovators

CORWIN HARDHAM,
KENNY JENSEN,
DAMON VANDER LIND
MAKANI POWER

Brilliant idea

A TURBINE THAT GOES
WHERE THE WIND IS —
HUNDREDS OF METRES OFF
THE GROUND

HIGH FLIERS



AS A KITE BOARDER, zipping back and forth across the surf, Corwin Hardham experienced at first hand the power of wind. As an engineer, he wanted to harness that energy with the ease and flexibility of the sport. Makani Power, which Hardham co-founded, now leads a small pack of start-ups eagerly attempting to tap into an unexploited resource – the strong, consistent winds blowing above 400 metres.

To do so, Hardham, with engineers Kenny Jensen and Damon Vander Lind, did away with 90 per cent

of the mass of a conventional turbine – namely, the tower – and instead mounted Makani's technology on a glorified string. But rather than resembling a kite, the sleek, 20-kilowatt Wing 7 prototype is equal parts airplane, helicopter and robot.

Weighing a mere 59 kg and spanning 8,5 metres, Wing 7 takes off vertically with rotors up, rotates into horizontal flight and autonomously flies in swooping circles. Wing-mounted turbines generate electricity, transmitting it to the ground through the tether. A first-of-its-kind vertical tail wing



Standing with Wing 7, from left, control systems engineer Kenny Jensen, CEO and CTO Corwin Hardham, and systems engineering lead Damon Vander Lind.



VIDEO > Visit www.popularmechanics.co.za to watch a video of a recent flight of Makani Power's latest prototype, Wing 7.

allows the craft to transition through the various flight modes, Hardham says: "It's a whole new take on aviation."

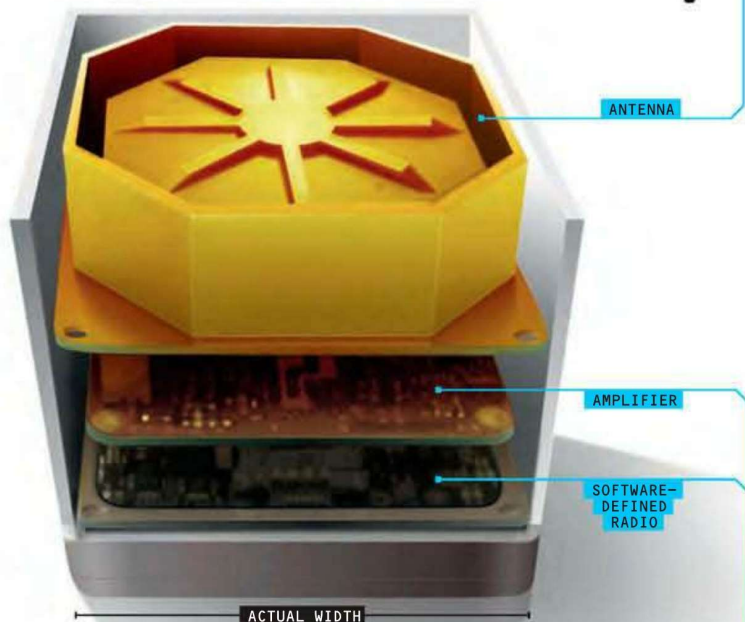
Eventually, fleets of autonomous, power-producing craft may be tethered to land or to buoys at sea. With funding from the US Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E) – as well as from venture capitalists such as Google founders Larry Page and Sergey Brin – Makani plans to develop a 1-megawatt unit by 2013 that can fly above 550 m, with hopes of taking it to market two years later. The company's ultimate goal is to tap the jet streams above 7 000 m, which contain roughly 100 times the energy currently used worldwide.



Picture by Phillip Toledano/Illustrations by Alexander van Daalen (lightradio cube), Dogo (wind turbine)



VIDEO > Watch a video demo of the lightRadio cube solution by Alcatel-Lucent on www.popularmechanics.co.za



Innovator

TOD SIZER BELL LABS

COMMUNICATIONS

Brilliant idea

BROADBAND BEAMED BY A RUBIK'S CUBE

A TINY CELL TOWER

WITH PREDICTIONS of a thirtyfold increase in mobile data demand by 2015, Tod Sizer, head of wireless research at Bell Labs, knew something had to give. "There's no way we can put up 30 times as many cell towers as there are today," he says. So he did what any high-tech engineer would do – he went to his workshop. Sizer cut a 60 mm cube, attached an aluminium plate to represent an antenna, and handed it to his team, telling them to re-think everything.

Their solution, the lightRadio cube, drastically shrinks the antenna and combines it with an amplifier to boost the signal. Digital-processing functions, which currently hunker in a building at a cell tower's base, will be consolidated in facilities up to 40 km away. Sizer compares this Lego-block approach to multi-core computer processors. "The future," he says, "is not about higher- and higher-power solutions. It's about lower-power solutions serving a smaller number of people with the same amount of data."

According to the company, arrays of the cubes – affixed to skyscrapers, airport terminals, bus stops – can increase broadband capacity by 30 per cent while cutting operation costs and energy consumption in half.

The lightRadio cube won't topple all towers – they'll still be needed along roadways and in rural areas – but it should greatly reduce their proliferation. It should also revolutionise cellphone service in the cities of resource-strapped developing countries.

LIGHTRADIO CUBE → •
60-MM SQUARE

TRADITIONAL CELL TOWER →
28 METRES TALL





Innovator
ELON MUSK
SPACEX

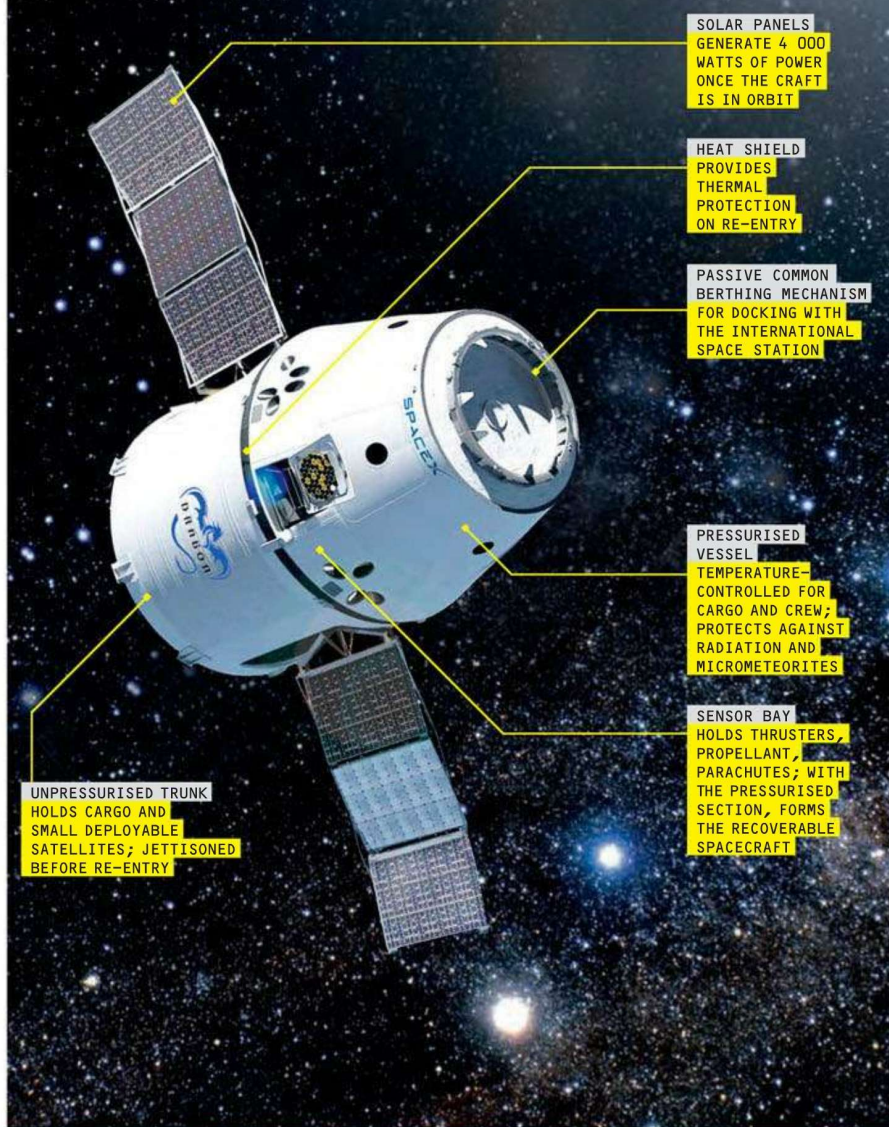
Brilliant idea
A SPACECRAFT THAT CAN DELIVER BETTER
PERFORMANCE AT LOWER COST

LAUNCHING PRIVATE SPACEFLIGHT

IT'S BEEN a stellar 18 months for SpaceX. The aerospace company signed a R3,88 billion launch contract – the largest in history – with satellite company Iridium Communications. It received a R590 million slice of Nasa pie to develop an escape system for its Dragon spacecraft. And in December, it became the first private company ever to launch a craft into orbit and successfully recover it: after circling the Earth twice, the unmanned Dragon splashed down within 1,6 km of its target in the Pacific Ocean.

"I think it's important that humanity try to become a multi-planet species," says SpaceX founder and CEO Elon Musk, a former South African who has been profiled in earlier issues of PM. "If we're not steadily improving our access to space, making it more reliable at lower cost and at larger scale, that will never happen." The company says the Dragon capsule will be able to lift seven astronauts into orbit atop its Falcon rocket – more than double the capacity of the Russian Soyuz, at less than one-third of the price per seat.

Nasa engineer and 2010 Breakthrough Award winner Daniel Andrews calls SpaceX's achievements "necessary and impressive", poised to create "very real, high-tech jobs in a new market sector". In fact, at press time, SpaceX advertised 130 open positions.



The Dragon's first cargo delivery to the International Space Station is planned to launch on 30 November; the first manned mission in 2014.

TNT IN YOUR HANDS.

AND A DETONATOR

AT YOUR RIGHT FOOT.



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BREAKTHROUGH 2011

CONSUMER TECH

THE YEAR'S 10 MOST
TRANSFORMATIVE
PRODUCTS



MOTOROLA ATRIX 4G

- THE ATRIX 4G is a topnotch smartphone with a dual-core Tegra 2 processor, 4G wireless speeds and a super-sharp 540 x 960-pixel screen. But what makes it revolutionary is a hidden talent: it's also a computer. When connected to the Motorola Lapdock, the Atrix switches modes – and becomes the heart, soul and brain of an 11,5-inch laptop. With the Atrix, Motorola has taken the first step toward a future in which one device serves as the nerve centre of many.

Microsoft Kinect for windows software development kit

- **As a gaming device,** Kinect was a hit. PM gave its user interface, Project Natal, a Breakthrough Award in 2009. But it wasn't until hackers got their hands on the motion-control technology for Xbox 360 – with its infrared camera, laser depth sensors and microphone array – that Kinect's true potential emerged. UC Davis students used the depth sensors for 3D video conferencing; at the University of Minnesota, Kinect became a tool for identifying ADD, OCD and autism in kids; Microsoft even demonstrated a lounge chair propelled and steered with hand gestures (right). In the software development kit, Microsoft not only sanctions hacking, but provides programmers, researchers and artists with the tools to do it. That's the kind of breakthrough-enabling attitude we love. (Free)



VIDEO

> Using the Kinect, Taylor Veltrop's two robots danced simultaneously under his control. Watch the video on www.popularmechanics.co.za

Square reader, Square and Card Case apps

- **Turning an idea** into a business is hard enough without having to deal with the byzantine rules of merchant banking. Square, co-founded by Twitter's Jack Dorsey, makes accepting credit card payments as easy as setting up an e-mail account. With Square's card reader and associated apps, any iPad, iPhone or Android handset can process transactions on the spot. Signatures register on a touchscreen, and receipts go out via e-mail.

Square's eponymous new app turns mobile devices into full-fledged point-of-sale terminals with a visual inventory; Card Case further simplifies the process, storing payment info in a secure app to allow wireless, instant purchases at Square-ready stores. (Free, plus 2,75 per cent of each transaction.)



Rockstar Games' *LA Noire*

● **It's the video game** that could provide a definitive response to the question, can games be art? Cinema-grade MotionScan technology allows actors, such as *Mad Men*'s Aaron Staton (seated), to actually play their characters (inset), giving Rockstar Games' *LA Noire* an exhilarating level of realism. A detective's brow furrows in frustration. A witness's lips purse. When suspects lie, it's revealed in the lines of their faces. The effect is at once uncanny and cinematic – and certainly unprecedented. Gamers will never look back.

ON THE WEB > Read the *LA Noire* game review on www.popularmechanics.co.za



Parrot Asteroid receiver

● **According to consumer marketing** firm RL Polk, the average age of cars and trucks on US roads today is about 11 years. (And South Africa? It's anyone's guess.) In tech terms, that's an eternity. The Asteroid, Parrot's drop-in receiver, is a simple way to turn any older model into a connected vehicle. Powered by Google Android software, the Asteroid includes voice recognition, hands-free calling and connections for popular smartphones and media players. It also supports 3G mobile Internet, enabling apps for navigation, Internet radio and, well, anything else developers come up with.

Ford rear inflatable seat belts

● **Seat belts haven't changed** dramatically since the introduction of the three-point model in 1959; that is, until Ford combined rear belts with another important safety feature: the airbag. Available as an option in the 2011 Explorer, the belts activate with compressed gas via a specially designed buckle. As it breaks through the fabric, the airbag provides support for more than five times the body area of a normal belt. This reduces pressure on the chest and further secures the neck and head during an accident, especially important for children and older passengers.



VIDEO > Visit www.popularmechanics.co.za to watch a video of Ford's inflatable seat belts.



BORALPURE SMOG-EATING TILE



- **Using some creative chemistry**, Boral Roofing has turned a standard building material into a formidable weapon – not just against sun and rain, but also air pollution. The tile's coating contains TiO_2 (titanium dioxide), which reacts with and neutralises NO_x (nitrogen oxide) particles in smog. The by-product is a harmless precipitate that accumulates on the roof and washes away in the rain. That's pollution removal at its best. No machinery. No moving parts. No energy input other than sunlight. Just a clever, air-cleansing chemical reaction.

Solaria photovoltaic panels

- **Solar power has a problem.** In order for people to make the switch, solar technology needs to be cheap. The silicon required for standard photovoltaic (PV) panels, however, is extremely expensive. Solaria struck upon an elegant solution with its monocrystalline panels: use 50 to 70 per cent less silicon. Rather than covering the entire module with PV panels, Solaria leverages a patterned-glass lens to refocus light on to a strip of solar cells.

The module is durable; the proven operating life is longer than 25 years. And because the product uses the supply chain already established in traditional solar panel manufacturing, overall costs remain low. (Price in the US: one-third less than a solar panel of comparable efficiency.)



Philips AmbientLED bulb

- **The AmbientLED** is the first credible LED replacement for the most common light bulb in America, the 60-watt incandescent – and it hits shelves just in time for new federal efficiency standards. At 800 lumens, the bulb is just as bright as its tungsten counterpart but consumes only 12,5 watts of power. And after hours of operation, it's merely warm to the touch. Philips' secret lies in remote phosphor technology, which generates a pleasing hue and diffuses light to create that familiar soft glow. One thing that may take some getting used to is the bulb's longevity: the AmbientLED is rated to burn for 25 000 hours, 25 times longer than a typical incandescent.



SkyProdigy automatic telescopes

- **Contrary to what the name suggests**, most "automatic" telescopes require calibration, and so take time and expertise to master. "Many people don't have that kind of dedication," says Eric Kopit, Celestron's director of development. The company's SkyProdigy series – which includes refractor, reflector (130 mm, left) and Maksutov-Cassegrain-style models – makes looking into the cosmos truly effortless. With built-in tracking cameras and a digital database of more than 4 000 heavenly objects, the SkyProdigy telescopes sight themselves in less than three minutes, so even a first-time stargazer can experience the thrill of discovery.



PM

Studio D

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NEW ON THE BLOCK

Headlines from around the automotive world >>>

COMPILED BY ANTHONY DOMAN
anthony@ramsaymedia.co.za



GROWING FAMILY

2012 TOYOTAS

From compact entry-level cars to “people connectors”, from racy concepts to sporty hatchbacks, Toyota rang the changes at the Johannesburg International Motor Show.

INNOVA

Built on Toyota's Innovative International Multipurpose Vehicle platform, the Innova brings the company's total number of model ranges to a staggering 17. However, although sharing a base with LCVs – the Hilux and Fortuner – the Innova was designed from the outset as a passenger vehicle: it rides on double wishbone independent front suspension with stabiliser bars and four-link rear suspension.

The Innova is available in either 7- or 8-seat configuration, both versions being powered by the same 118 kW 2,7-litre VVT-i four-cylinder petrol engine. Fuel consumption is 11,2 litres/100 km on the combined cycle and CO₂ emissions are at 265 g/km.



This is no basic bus, either: the woodgrain inserts and optional leather trim are the immediately visible signs of a comprehensive features list that includes a multi-information display, electric windows, steering wheel controls for the audio, Bluetooth and dual climate control that pipes air to the rear.

There are plenty of fold/tumble options for seating configurations, and the third row of seats, which is good for occasional trips for adults, folds sideways like the Fortuner's. The 7-seater gets a pair of middle-row “captain's chairs”.

Driver and passenger airbags are standard, as is ABS braking. Pricing is pretty competitive, starting at under R250 000.



ETIOS

Toyota used the Johannesburg International Motor Show to offer the first glimpse of its Etios entry level hatchback and sedan, which is set for local introduction in 2012. The Indian-built Etios will be offered with sedan or hatchback body style. Its all-new 1,5-litre petrol engine delivers 66 kW at 5 600 r/min and 132 N.m at 3 000 r/min. Fuel consumption is quoted as 6 litres/100 km on average.

The engine is rated to deliver an average of 6 litres/100 km in an average usage cycle.

Aimed at the budget-conscious buyer, the Etios will be offered in a wide range of specifications, with a service plan as standard.

**AURIS TRD**

On the back of the company's showing with the Auris in local rallying, Toyota has unveiled a supercharged version that revives the Toyota Racing Development (TRD) nameplate.

Engine power of the 1,6-litre Valve-matic engine is boosted to 133 kW at 6 400 r/min, while torque is upped to 202 N.m at 5 200 r/min. A 6-speed gearbox is standard, as is a TRD Sportivo Suspension kit.

Externally, the Auris TRD wears the same body kit as the SportX version, which it replaces.

**AURIS HYBRID SYNERGY DRIVE**

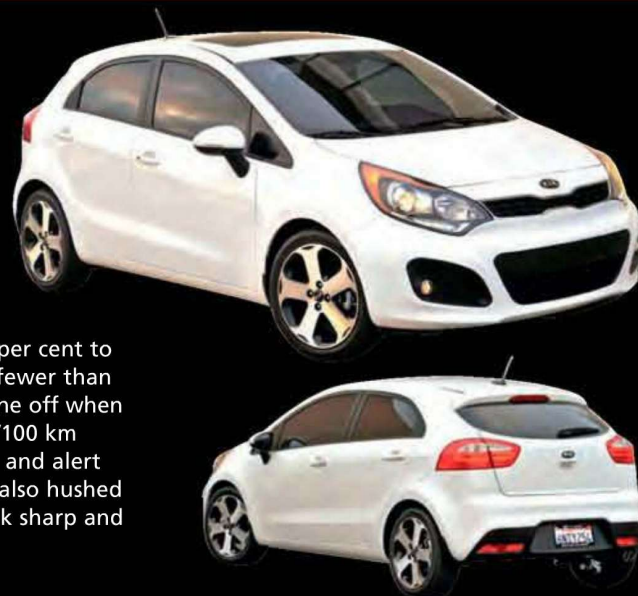
0,07 may not sound like much. But in the race for economy on-mpmanship, it's plenty. So, the new-look front end for the British-built HSD is not just about cosmetics: in conjunction with a sleeker grille and a redesigned front bumper and underbody, the new nose helps cut drag coefficient of this vehicle from 0,29 to 0,283, contributing to lower fuel consumption and CO₂ emissions.

Powered by a version of Toyota's Prius Hybrid Synergy Drive system, the Auris HSD has a drivetrain with electric motor, generator and power split device housed in a single transmission casing that is the size of a conventional gearbox.

The four-cylinder 1,8-litre Atkinson Cycle engine develops 72 kW, and is partnered by a synchronous 60 kW electric motor that generates peak torque of 207 N.m. The overall effect, Toyota says, is like driving a 2-litre diesel.

RIO, BRAVO!**2012 KIA RIO**

The last time we toiled around in Kia's Rio, in 2009, we gave high marks to the subcompact's quick feel and fun quotient, but noted highway noise, the lack of power locks and windows, and the interior's discount plastics and upholstery. The manual locks and window cranks remain on the LX trim version of the all-new Rio. (Powered hardware comes with the EX, which we drove, and the SX trim.) But burrowing through 25 tunnels on a coast-to-coast route across rumpled South Korea, we confirmed that the quickness and fun remain – in fact, they've improved. Kia's direct-injection system boosts output from the 1,6-litre engine by 25 per cent to 103 kW, which made it tough to stay legal under the watchful eyes of no fewer than 27 speed cameras. The Idle Stop and Go system, which subtly turns the engine off when the vehicle is stationary, helps boost the sedan's fuel economy to 8/6 litres/100 km (city/highway). The handling is tight, and the 6-speed automatic is smooth and alert to downshifts. (A 6-speed manual comes with the LX.) Kia engineers have also hushed the roomy cabin, and the fabric seats and leather accents make the EX look sharp and athletic, not bargain-basement. – DAVID DUNBAR





ALL WHEELS GOOD, TWO WHEELS BETTER?

SUBARU XV AND BRZ 'PROLOGUE'

The final production version of Subaru's new XV – the company's first foray into the compact crossover market – follows the design concept first shown at the Shanghai show in April. As usual, it will be underpinned by Subaru's symmetrical All-wheel drive and advanced Subaru dynamic chassis control concept.

Created around the concept of "urban adventure", the XV will be available for the Euro market with 1,6- or 2,0-litre petrol engine, or a 2,0-litre diesel. The vehicle has been specifically engineered for easy access to the spacious interior, which has plenty of stowage areas. It's the first time in 21 years that Subaru has developed a new, environmentally friendly (yet still horizontally opposed) FB-designated engine to replace the EJ power-unit currently used across all Subaru vehicle lines. Its performance characteristics are more focused on torque in the low- and mid-speed ranges.

Concurrently, a new lightweight, compact Lineartronic CVT has been developed for the XV. Six-speed and five-speed manual transmissions are also available.

Safety is a key focus area. Integrating the partition windows into the front doors and positioning the door mirrors on the door panels has helped create what Subaru says is class-leading forward visibility and reduction of blind spots. Driver and passenger's airbags, side airbags, curtain airbags and driver's knee airbag are installed as standard in all models, as is uprated VDC (Vehicle Dynamics Control) and brake assist.



Alongside the XV at Frankfurt was an "enhanced model" of the BRZ, which is a significant departure from Subaru's recent all-wheel-drive history. The front-engine rear-drive sports car is being jointly developed with Toyota, with production scheduled for 2012. At Frankfurt, the BRZ Prologue showcased Subaru technology, built around the horizontally opposed Boxer engine configuration. The production BRZ will feature an exclusively developed all-new 2,0 litre direct injection boxer engine.

TAKING AIM **HYUNDAI i30**

Launched at this year's Frankfurt Motor Show, the hatchback i30 is an important model for Hyundai internationally. It's designed to go head-to-head with the big players in Europe.

The new-generation i30 will go on sale in Europe early in 2012 as a five-door hatchback. Hyundai is planning to sell on average over 120 000 units of the new i30 a year during the car's lifecycle, capturing a larger market share of around 5 per cent and challenging established competitors. (No South African launch date is available yet.)

As senior vice-president Eusun Chung conceded to PM, it's not going to be easy to win over the Euro market. However, he is confident that, provided that quality is not compromised, the company will continue to make headway. Technology will come to play an increasing role, he said, confirming that we can also expect to see more of technologies such as the multi-mode steering implemented on the i30.

Designed and engineered at the Hyundai Motor Europe Technical Centre in Rüsselsheim, Germany, the new-generation i30 represents a further evolution of Hyundai's "fluidic sculpture" design lan-

guage. Senior vice-president and COO of Hyundai Motor Europe Allan Rushforth told media at the vehicle's launch that it's gone "from sensible to sensational".

The new-generation i30 will be available with a choice of three petrol and three diesel variants, with power outputs ranging from 67 to 100 kW. In Europe, where diesel represents a little over half of total vehicle sales, Hyundai is expecting a 50:50 split between diesel- and petrol-powered i30 sales.

Technologies available under the company's Blue Drive sub-brand, which optimises efficiency and lowers emissions, include Integrated Stop & Go (ISG), low rolling-resistance tyres and an alternator management system.

Hyundai's new Flex Steer option offers three operating modes – Comfort, Normal and Sport – to vary the level of steering assistance and feedback. A large TFT



Supervision cluster is matched by a 180 mm touch-screen display for the sat-nav system.

Safety features include anti-lock brakes, stability control and six airbags as standard – front, side and curtain - while a driver's knee airbag is optional.



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“M” IS FOR MORE

2011 MERCEDES-BENZ M-CLASS

With cleaner lines and a cushier interior, Mercedes-Benz's third-generation M-Class is a ground-up redo that's nominally longer, wider and lower than its predecessor, with a lengthier list of standard equipment at the same starting price. The ML comes with a choice of two direct-injected powerplants: a 3,5-litre petrol engine (225 kW, 370 N.m) or a 3,0-litre diesel (180 kW, 616 N.m). On the open road, the M-Class was more of a comfy long-distance cruiser than a viscerally rewarding performance machine. Higher-powered variants due in about a year should satisfy lead-foots when they arrive. Until then, the ML delivers a solid people mover – yeah, it's got all-wheel drive, but it's no off-roader – that slots squarely between the smaller GLK and the plus-size GL. – BASEM WASEF

BENCHMARKER

PORSCHE CAYMAN R

Enthusiasts believe that the more stripped-down and pure a Porsche is, the tighter the bond between man and machine. Enter the Cayman R, an even more focused version of the Cayman. Engineers carved about 50 kg from the

sportster by using lighter components. The interior door handles were removed and replaced by fabric pull loops. Even the air conditioning was sacrificed. Yet despite the pared-down features, the R costs significantly more than

the Cayman S. Buyers do at least get another 7 kW from the 3,4-litre flat six (246 total). But really, what the Cayman R delivers is an unmatched driving experience. The steering provides the most direct and natural feel of any car we've

driven. The suspension tune is equally brilliant on any surface, too. But the incredibly supportive and comfortable seats do tend to hold in the heat when there's no air conditioning. Our advice? Wear shorts. – BEN STEWART

BENT REALITY

2012 JEEP GRAND CHEROKEE SRT8

As we rocket over a deserted stretch of the Angeles Crest Highway north of LA, our senses tell us we're driving a high-powered V8 sports sedan – not a 2 340-kg SUV with a 2,5-ton tow rating and 1 945 dm³ of cargo volume. The full-throttle response out of a corner pins passengers against the seats, the adjustable suspension minimises body roll but doesn't ruin the ride, and the steering communicates road surface nuances while filtering out extraneous static.

The high-performance and high-luxe 2012 Jeep Grand Cherokee SRT8 is among Chrysler's Street and Racing Technology group's hottest creations and will arrive in the US before year-end (that could put its South African arrival about midway through next year). The 6,4-litre Hemi engine cranks out 350 kW and 630 N.m of naturally aspirated torque that makes 100 km/h arrive in the mid-4-second range. The pull doesn't stop until 255 km/h. Time to go hunting Porsches. – REX ROY



CALL BACK THE PAST

2011 MG6

One of motoring's storied marques has been relaunched in South Africa with its first all-new model in 16 years. MG, now run by Shanghai Automobile Industry Corporation (SAIC), will be brought in by Combined Motor Holdings Limited (CMH). The MG range will be distributed initially through 15 dealerships nationwide, with four more to follow soon after.

The all-new model, dubbed MG6, is powered by a turbocharged 1,8-litre that delivers 118 kW at 5 500 r/min. It is mated to a 5-speed manual gearbox. According to MG South Africa management, the MG6 offers a luxury specification at a competitive price.

MG owners SAIC are the largest motor manufacturers in China – and produces nearly 3,6 million cars annually. The company's two plants in China are backed up by a third in Birmingham in the UK, where its design studio and engineering facility were established at a cost of more than half a billion rand.

MG has made it clear that it will continue to focus on European and more specifically British styling and design. It will also continue to build on its racing heritage, with a return to the Le Mans 24-hour and the British Touring Car Championship.

PM



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UPGRADE

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California Roll House



Designer Christopher Daniel had a vision. He wanted to design a house that adapted to its environment, a prefabricated cube that could morph into something completely different to comfortably accommodate people in the harshest environments (think desert). The result is California Roll, a delightfully quirky concept house featuring a homogeneous exterior material that aims to provide optimum energy efficiency, its glass panels allowing electronic adjustment of their transparency. As the designer tells it, all structural members and finish materials are modularised to allow for maximum mobility as well as rapid assembly and disassembly on site. A carbon fibre truss frame hidden beneath the exterior shell supports the structure. Hydraulic power is used to open and close the doors.

Has anybody tried to build one? Er, no.





CONNECTED COMMUTER

EN-V concept vehicle



GM's next-generation EN-V concept vehicle, representing the manufacturer's plan to meet the demand for safe, connected, zero-emissions personal transportation, could participate in pilot demonstration programmes in megacities around the world in a bid to determine real-world practicality.

According to Chevrolet's Chris Perry, the two-seater, electric urban mobility concept represents a possible solution for customers in markets where alternative transportation solutions are needed.

GM says its next-generation Chevrolet EN-V (Electric Networked-Vehicle) concept will add new features such as climate control, personal storage space and all-weather and road condition operation while preserving key elements of the original EN-V, such as the small footprint and manoeuvrability. It will also retain its battery electric propulsion, connectivity and autonomous driving capabilities.

By combining GPS with vehicle-to-vehicle communications and distance-sensing technologies, the EN-V can be driven manually or autonomously. In autonomous mode, the EN-V offers mobility to people who may not otherwise operate a vehicle.

By leveraging wireless communications, it allows drivers and occupants to communicate hands-free with friends or business associates while on the go.

Where do you put the groceries? That's not really the point, is it?



VIEW FROM THE TOP

Throwable panoramic camera

German computer engineer Jonas Pfeil and colleagues have come up with a new take on aerial photography – a foam sphere equipped with 36 cellphone cameras that's tossed into the air to capture a panoramic picture of its surroundings.

Hold on... won't this produce blurred images? Not at all: as its designers explain, their "throwable panoramic camera" captures images at the apogee of its flight – that is, when the ball is hardly moving. Says Pfeil, a graduate from the Technical University of Berlin: "The camera takes full spherical panoramas, requires no preparation, and images are taken instantaneously. It can capture scenes with many moving objects without producing ghosting (effects), and creates unique images."

The 2-megapixel fixed-focus camera modules are mounted inside a robust, 3D-printed, ball-shaped enclosure that's padded with foam and handles just like a ball. The ball contains an accelerometer that measures launch acceleration, whereafter the software calculates the optimum trigger point. After the thrower catches the descending ball, the images are downloaded via USB and displayed on a spherical panoramic viewer that comes bundled with the camera. As with Google's Street View, the viewer allows you to pan and zoom.

Sadly, the camera ball is not yet commercially available.



VIDEO

> Catch the Throwable Panoramic Ball Camera in action on www.popularmechanics.co.za

Jonas Pfeil/jonas Pfeil.de/ballcamera



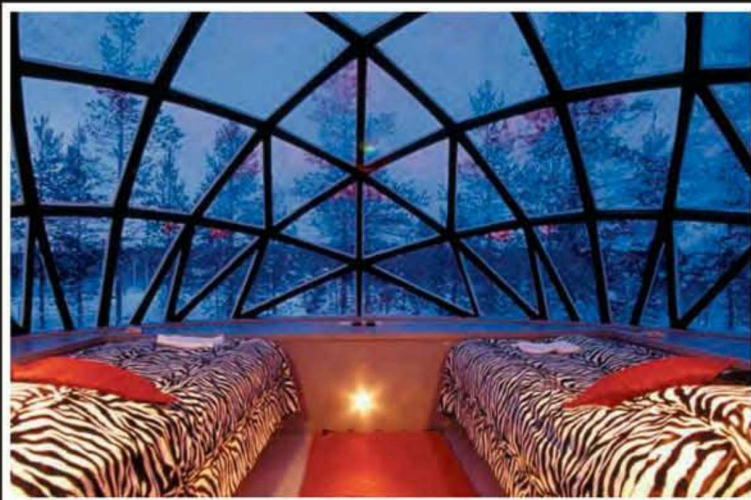
BABY, IT'S COLD OUTSIDE

Igloo village

Ever heard of the Hotel Kakslauttanen? It's located in the Saariselkä area of Lapland, in the vicinity of Urho Kekkonen National Park. What makes this place special is its unusual winter accommodation options, which include a stay in a traditional snow igloo or a unique futuristic glass igloo, from where you can admire the Northern Lights at "normal room temperature".

There are 20 glass igloos, all built from a special thermal glass that maintains a toasty-warm interior and prevents the formation of frost on the outside, which means you get a good view even at horrendously low temperatures... reportedly as low as minus 30 degrees. (Of course, this suggests that people on the outside can also look in – but then again, if people are prepared to go to that much trouble in sub-zero temperatures, perhaps they deserve a peek.)

Still not ready to commit your holiday cash? Then consider this: the hotel's newest attraction is Santa's Resort, "home to Santa Claus all year round" and repository of such compelling attractions as an elf forge. Okay, we're convinced.





Natural living

ONE MAN BUILDS AN ECO-FRIENDLY HOME ON A BUDGET

> STORY BY SEAN WOODS

Building a conventional home using bricks and mortar is all very well – as long as you don't mind selling your soul to your bank manager for 20 years and living in an unimaginative rectangular box, that is. For Simon Dale, this utterly conventional approach to domesticity held little appeal. Not cash-flush enough to raise a bond, and wanting his family to live close to Nature, he decided to build his own eco-friendly home. He accomplished this feat in just four months for less than R40 000.

The Dale family's quirky dwelling, situated in the Welsh countryside, conjures up images of The Shire and that fictional abode of Bilbo Baggins, made famous by JRR Tolkien in his fantasy novels *The*



Hobbit and *The Lord of the Rings*. But, as outlandish as it may seem to those unfamiliar with environmentally friendly building methods, make no mistake: the rationale behind its design and construction methodology is based firmly in reality.

Here's why. The whole point of eco-friendly construction is to use as much of the available natural material in the vicinity as possible. And all Dale has done is incorporate what his corner of rural Wales provides – namely wood, stone, straw, mud and, oh yes, turf. Lime plaster, a breathable and greener alternative to cement, coats the interior and exterior walls. Inert black plastic sheeting was used in the foundation and roof to prevent water ingress. The rest – wooden flooring, windows, wood burner, plumbing, wiring, fittings and the like – he simply scrounged. "Anything you could possibly want is in a rubbish pile somewhere," he says.



The building is one part of a low-impact or permaculture approach to life, Dale explains. "This sort of life is about living in harmony with both the natural world and ourselves, doing things simply and using appropriate levels of technology. We built this place to house our family while we worked in the surrounding woodland doing ecological woodland management and setting up a forest garden, things that would have been impossible had we needed to pay a regular rent or mortgage."

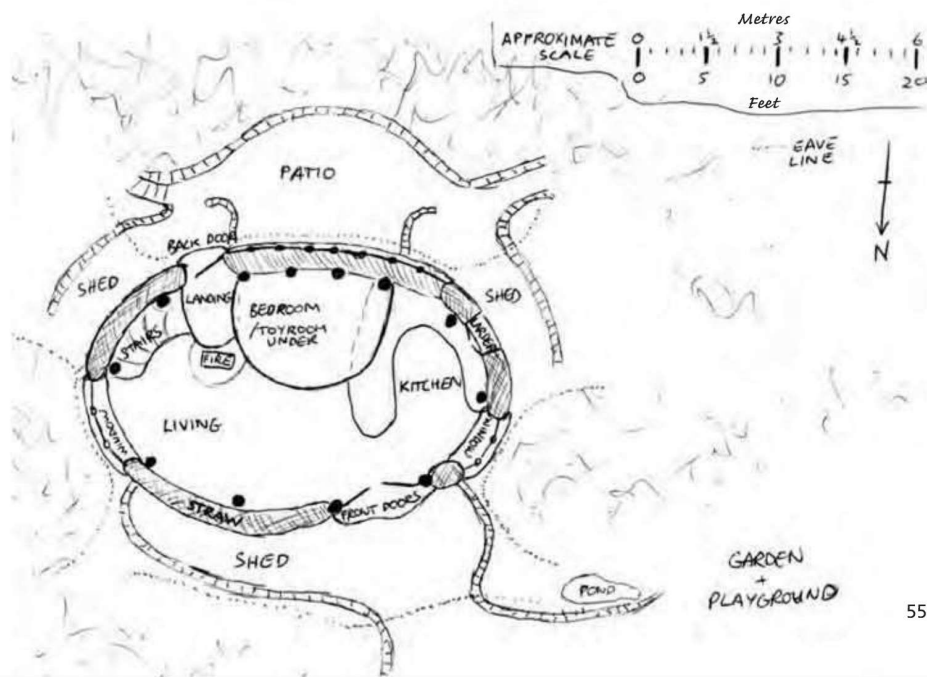
That he went for a decidedly unconventional, hobbit-like design is his prerogative.

So, working from this environmentally friendly building premise, it stands to reason that, if you live somewhere like the Free State where there's plenty of grassland, straw bale construction would make perfect sense. If, on the other hand, there's plenty of clay in the area, cob construction would be ideal. And if you live in or near a pine plantation, vertical log construction would be a no-brainer. Heck, if you're lucky enough to have some land in the Amatola Forest near Hogsback in the Eastern Cape (where legend has it Tolkien got his inspiration for *The Hobbit* and *The Lord of the Rings*), you could most probably even go for Dale's exact design.

Top left: Once the hillside excavation was complete, the dug-out stone and soil was used to construct a drystone foundation and retaining walls. **Top right, bottom left:** Only young oak trees deemed too spindly for conventional applications were used to construct Dale's home. **Above right:** Aside from a chainsaw, hammer and wood chisel, Dale relied on muscle and ingenuity to get the job done. **Here he is seen attaching split logs to the reciprocal roof's rafters to support the roof, which comprises straw bales, soil and turf.** **Below:** A bird's eye view of Dale's design.

Getting started

Once Dale had secured a piece of land from a friendly farmer, he, his father-in-law and a few visiting friends got down to business. The plan was to dig into the hillside to create as low a visual impact as possible. Because it would take too much manual labour to achieve this by themselves, they borrowed a knackered old digger the landowner already had on site. This enabled them to excavate the area to the required depth so they could incorporate a mezza-



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- Weather (near you, near your destination and near another location)

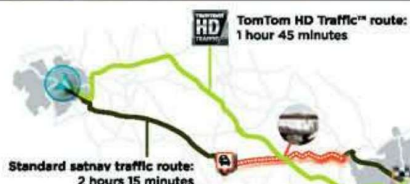
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nine floor. Once the hole was completed and the ground levelled, they used the excavated stone and mud to construct dry-stone foundation and retaining walls.

About 30 round oak posts between 12 and 25 cm in diameter were sourced from the surrounding woodland to construct the oval frame. As the trees were deemed too spindly for conventional use (except for firewood, fencing or mulching into wood-chips), they were felled as part of the ongoing programme of woodland thinning to allow selected trees space to grow to maturity. Says Dale: "Basically, all this required was a chainsaw, a few able-bodied helpers and plenty of heavy lifting."

Reciprocally speaking

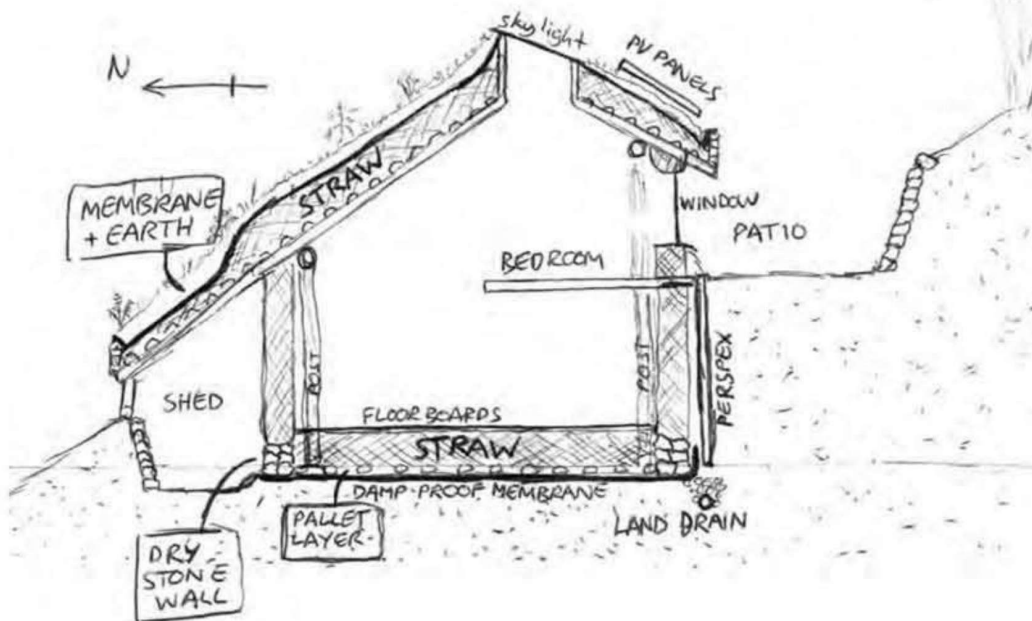
Once the vertical posts had been secured in the ground, a ring of horizontal logs was attached to the posts using open mortise and tenon joints to create the much-needed roof plate, and work on the reciprocal roof could begin.

Reciprocal roofs are ideally suited to round wood construction: they require minimum woodworking and are structurally uncomplicated (because they don't push outwards on the walls, they don't require tie beams). "Although constructing a reciprocal roof is relatively easy, getting your head around the technique can be a bit tricky," Dale warns. "I recommend having a go with a few small sticks before trying the real thing."

To start off with, you temporarily prop up the first rafter a little off the centre point of the essentially conical roof. When you're happy, lay the second rafter on top. Then lay the third and so on. The distance between intersections or crossing points can be checked by keeping the points where the rafters touch all in a level plane as you work around. "The rafters should be fixed temporarily as you go," advises Dale. "Nailing something about a metre long between the rafter and the previous one a little way down from the top seems best to me."

Then, when you get to the last rafter, you should find just enough of a gap to squeeze it in. If it's not quite right, a quick jiggle of the last few rafters should adjust the size of the gap. Once all the rafters are in place, you take the prop out from under the first. "This is the exciting bit. Hopefully you'll hear a creak and the inner ring drops by a few centimetres," Dale says.

"However, I would strongly recommend doing this with a good rope tied around the outside of the inner ring until the



Above: Side view of Dale's design, showing the various layers that make up the floor, walls and roof. **Below:** Dale's rustic, yet comfortable eco-home took just four months to build and cost less than R40 000.

final fixing is complete. And, though it barely needs it, fixing the rafters together is recommended. I used 2,5 cm diameter wooden pegs although rebar, nail tape or 15 cm nails are good alternatives."

Finishing off the roof involved applying a series of layers to achieve insulation, water-proofing and low visual impact with little cash. First, cotton dustsheets were laid over the multitude of split logs that had been attached in a symmetrical pattern to the rafters. Next, whole straw bales were packed on top, followed by three layers of plastic membrane. Earth from the original excavation was packed on top of the plastic and, finally, tufts of grass were planted into the soil to make everything, well, nice and green. Finally, a skylight was placed over the reciprocal roof's central opening to let in plenty of natural light.





Left and inset: The Dale family's unconventional home, situated in the Welsh countryside, conjures up images of The Shire and that fictional abode of Bilbo Baggins made famous by JRR Tolkien in his fantasy novels, *The Hobbit* and *The Lord of the Rings*.

mix of sand and lime, he trimmed the bales to ensure they were all nice and smooth.

"I used a chainsaw for this job. A hedge trimmer would probably work better and garden shears will do the job too, albeit a bit slower. I have also spoken to people who swear by an angle grinder fitted with a metal cutting disc."

Having chosen such an unconventional structure as a home, the last thing

Dale wanted was to fabricate a run-of-the-mill floor. "Instead I decided to go for a completely experimental technique which seems to have worked well." He started by covering the ground with builder's damp proof plastic. On top of the plastic he placed scrap wooden pallets before covering the entire floor with a single layer of straw

bales. The floorboards (reclaimed crate lids, each measuring 2 x 1,5 m) were laid directly on top of the straw and joined together using wood scraps. "This was very easy and cheap to do. It made a floor that's not completely flat or level, although it's perfectly practical. It's also quite springy, which I quite like."

Other features Dale added included solar panels (for lighting, music and computer), compost toilet and a fridge that's cooled by air coming underground through the foundations. The flue of the wood-burning stove goes through a big lump of stone and plaster to retain and slowly release heat. Water is gravity-fed into the house from a nearby spring. And water collected from the roof runs into his pond, enabling him to water his garden.

What makes Dale's feat so impressive is the fact that he had just a modicum of building experience before he started. "My only experience was having a go at one similar house two years before and a bit of mucking about in between," he explains. "My main relevant skills were being able-bodied, having self-belief and perseverance. Plus, of course, having a mate or two to give a lift now and again. This kind of building is accessible to anyone."

● To find out more, visit Simon Dale's Web site www.simondale.net/house **PM**

Bring on the straw

Straw bale construction is nothing new; after all it's been around since the 1800s. However, don't let that detract from its ability to create superbly energy-efficient buildings. It's also incredibly easy, cheap and fun to build with the stuff. "Straw is a great insulator," says Dale "It gives heat savings of up to 75 per cent compared with a conventional modern house. Straw bale walls have excellent load-bearing capacity and are quite suitable for double-storey houses fitted with all the mod-cons."

Constructing the basic walls simply involved stacking the bales as if they were giant bricks, then securing them to each other by hammering hazel stakes through their centres. The only thing Dale had to be careful of was to ensure the bales were laid in such a way that their straw ran horizontally, as this is the only way to prevent them from sinking into each other.

As straw walls need to be able to breathe to prevent the accumulation of moisture and rotting, placing them on a plastic damp-proof course (like one would when building with brick) is out of the question. So instead Dale placed them on top of his 45 cm high dry-stone foundation walls – that way, any moisture that finds its way into the walls can drain harmlessly out of the bottom into the ground.

Before finishing the walls off with a protective yet breathable render made out of a



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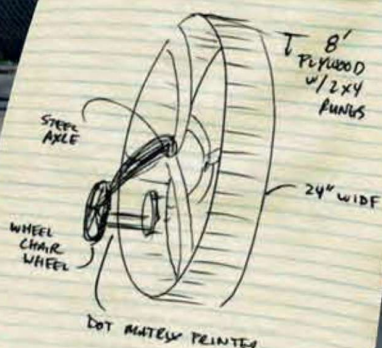
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72

HOURS TO TURN

THIS



INTO THIS

TEAM: 1.21 JIGAWATTS

Members: David Heisserer, Dillon Hodapp (in wheel), Cory Huseby, Nathan Knutson

Creation: Hamster-wheel dot-matrix printer

These *Back to the Future* fans built the winning creation: a human-size, plywood exercise wheel outfitted with a dot-matrix-style printer constructed from seven servo-controlled spray-paint cans. The printer was fitted with a cellphone antenna and SIM card, and audience members at the competition were encouraged to text words to the printer. The result was a painted word-salad trail somewhere between poetry and vandalism.



On an insanely hot Sunday in July, 16 sweaty, exhausted teams from around the USA rolled, pedalled, skated and cranked a collection of unusual machines across a tarred section of a New York City park. The teams were vying for the \$5 000 (about R35 000) grand prize in the first-ever Red Bull Creation event – an attempt to add a little competitive spirit to the nascent maker movement.

They had been given three days to hammer, weld and wire together as much as 100 kg of gear they brought with them with whatever they could salvage from a communal junk pile, as well as from the streets of New York City itself. On day one, the challenge was revealed: construct a device capable of moving a 100-pound (about 45 kg) person without using fossil fuels. The results would be judged by a panel of professional technology junkies, including POPULAR MECHANICS' senior editor (US) Glenn Derene.

What ensued was a down-to-the-wire drama of competition, imagination and a surprising amount of co-operation as the teams pursued the cash award and a state-of-the-art laser cutter for each winning team member. Most important, the winners got the ultimate in geek bragging rights – and the opportunity to bring forth order from chaos.



TEAM: INNOVATION THIRST

Members: Justin Griggs, Chris Horne, Greg Needel (above, right), Jeff Waegelin
Creation: Play-powered Pod

PM editor Glenn Derene (above, left) tried out a few swings on the team's moving playground, an ambitious attempt to turn swinging and see-sawing into electricity. It didn't quite work as planned. "It was way more mechanically sophisticated than we should have tried in 72 hours, but we wanted to be the team to go for broke," says team member Greg Needel.

Those who survived three sleep-deprived days of MIG welding, sawing, computer programming and wiring then had to demonstrate their vehicles in front of a crowd on a baking-hot parking lot.



TEAM: i3DETROIT

Members: Nathan Bezanson, Ted Hansen (right), Eric Merrill, Roger Slykhouse
Creation: Squiggle Trike

Inverting the Motor City's traditional fuel-exhaust relationship, i3 built a vehicle that uses compressed CO₂ to drive two lever-mounted, rotation-locked wheels from side to side, propelling the Squiggle Trike with a Rollerblade-like sweeping motion.



TEAM: TECHSHOP

Members: Sean Cusack, Danny Garcia (right), Charlie Nguyen (near right), Carter Stokum
Creation: ICU Later

Winners of the team award, TechShop created a see-saw that lifts riders 4 metres in the air and spins 360 degrees. At the 2 G's rotational mark, Polaroid cameras snap riders' photos. After the competition, the team shipped the contraption back home, where they plan to add pyrotechnics.





Some teams actually finished a few hours early, but Greg Needel of Innovation Thirst worked down to the wire, connecting the gearboxes before taking his hands off the team's project at the final second.



TEAM: EFFIN LADIES From "all over the effin' place"

Members: Sarah Kihls (above), Laura Leva, Zorah and Tirzah Rodgers. **Creation:** Human-powered beverage cooler

The Effin Ladies' ambitions got the better of them. The team of four worked tirelessly to create a near-inexplicable combination of elevator and refrigerator, which, unfortunately for them, neither elevated nor refrigerated in the public showdown.



TEAM: DONNER PARTY 2.0

Members: Grant Kaye, Justin Self, Randy Vasquez (on bike), Justin Winter **Creation:** Electric trike with blender/dryer trailer

Donner Party's custom three-wheeler had dual electric power systems with separate priorities. The trike was propelled by a lithium-ion electric-assist drive, but a second, 12-volt battery was hooked up to a blender hidden inside a salvaged, graffiti-covered dryer. The result was a legally dubious combination of vehicle and margarita machine.



Ending the **GADGET** **GUESSING** game

Q I was thrilled with my new laptop – until a better model hit stores two weeks after I got it. How can I avoid this kind of buyer's remorse?

A Of the countless tech-related questions I get from friends and family, one towers above all others: "When is the next iPhone coming out?" My answer is always the same: "I don't know. But I have a pretty good guess!"

At the heart of this question is a fear shared by all would-be gadget buyers: that something better is just around the corner, so buying now would be foolish. But if not now, when?

There is a small but fertile online industry dedicated to answering precisely this question, and the sites that algorithmically answer your when-to-buy queries work quite well. *Retrevo* (retrevo.com) monitors activity at online retailers, news wires and review sites to compile a dossier on virtually

every gadget in the world, including comparative price information, reviews and – crucially – a chart showing how far along a gadget is in its life cycle: "new", "reaching its prime", "over the hill" or "ready to retire".

Decide (decide.com), a newer product-tracking engine, gives more forceful advice, issuing a "buy" or "wait" recommendation and laying out products' full release histories. (At the time of writing, *Decide* indexes only laptops, televisions and cameras; the company says additional categories will be added soon.)

Anyone with questions specifically about Apple's products can refer to the venerable *MacRumors Buyer's Guide* (buyersguide.macrumors.com), which has been issuing

clear and dependable when-to-buy advice for Apple gear since February 2003. "Some people enjoy reading the rumours," says founder Arn Kim, "but the biggest reason to visit a site like ours is to get help making a buying decision."

If these sites don't settle your nerves, you can fall back on a few rules of thumb. Smartphones, tablets, cameras and televisions – most electronics, actually – are typically refreshed or replaced on a yearly schedule. Check the manufacturer's website to see if your desired gadget has been on the market for more than nine months, and adjust your plans accordingly.

Laptops and desktop PCs are trickier. Intel, which makes the processors in most of the computers on the market today, follows what it calls a tick-tock upgrade cycle. Every other year the company revamps the way it makes its chips so that its factories can squeeze more processors out of a given quantity of silicon (this is known as a die shrink, and results in lower prices and leaps in processor efficiency); the last time this happened was early 2010. In between these updates are smaller changes to the chips, called microarchitecture updates.

Buying at the beginning of the "tick" – the die-shrink phase – practically guarantees against buyer's remorse, but waiting a full year is often not an option. Computers with processors younger than nine months are a safe bet.

Lastly, beware of the sale trap. Unusually low prices may be a sign that a retailer knows something you don't and needs to clear its inventory to make way for an imminent replacement. Nothing ruins a great deal like instant obsolescence.

THE ACCIDENTAL APP BUYER

Q My toddler son, tech prodigy that he is, managed to buy a rather expensive app on my smartphone. Is there any way I can get my money back?

A Some smartphones require a password every time an app is purchased. Others don't – or permit a one-click purchase in a short window after the system password is entered. In any case, it's easy to accidentally buy an app yourself – or for a curious youngster to do serious damage to your wallet.

You have some recourse here, but nothing is guaranteed. If you use an iPhone, you can appeal your purchase. Find the necessary form by following a link in the

electronic receipt iTunes sends to your e-mail. Just click Report a Problem at the bottom of the receipt. You'll be taken to a website with a complaint form and a drop-down menu. Select "I inadvertently purchased this application" from the menu and describe the circumstances in the comment box. There's no certainty that you'll get your money back, but Apple is known to be lenient toward those who go to the trouble of asking.

Android app refunds are either much easier or far trickier, depending on your situation. If you notice your mistake immediately – for example, your young child taps Buy just before you're able to snatch your phone from him – you can uninstall the app for a full refund. The catch? You've got 15 minutes to do it. (In the Android market, select Menu and then My Apps, tap on the app, and click Uninstall and Refund.)

If the 15-minute window has closed, you can sign in to your Google Checkout account from a computer and request an order cancellation using the online form.

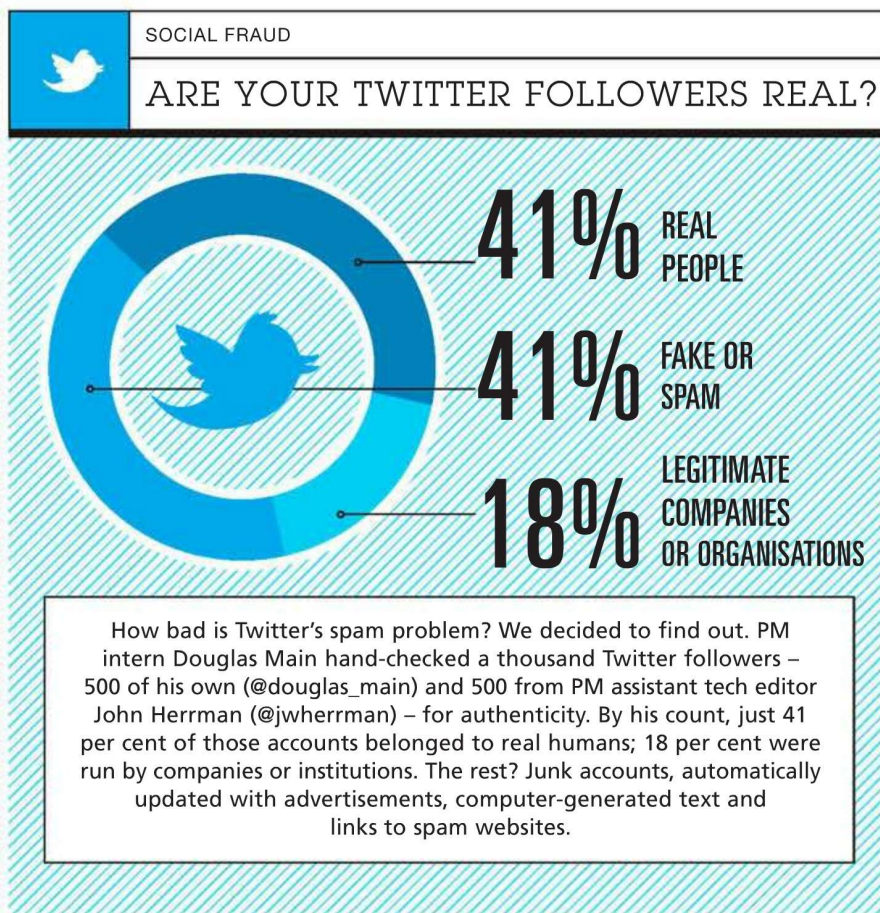
In this case, though, you're at the mercy of the app's seller. Good luck.

STARVING ARTISTS

Q Streaming music services sound like great deals, but here's what I don't get: if you can listen to unlimited music for a modest monthly payment, how on earth do the musicians get paid?

A All-you-can-listen music services do pay artists, albeit in an unusual way. Subscription and advertising revenue (after operating costs) is divided up based on proportional popularity. If one artist accounts for 20 per cent of total listens, for example, he gets 20 per cent of the total royalties. (Or, rather, his label does. A separate contract determines how much of this is passed on to the artist.) It's fair, but it's too early to tell if these services will find enough paying users to represent a serious source of income for artists. In any case, you can stream with a clear conscience.

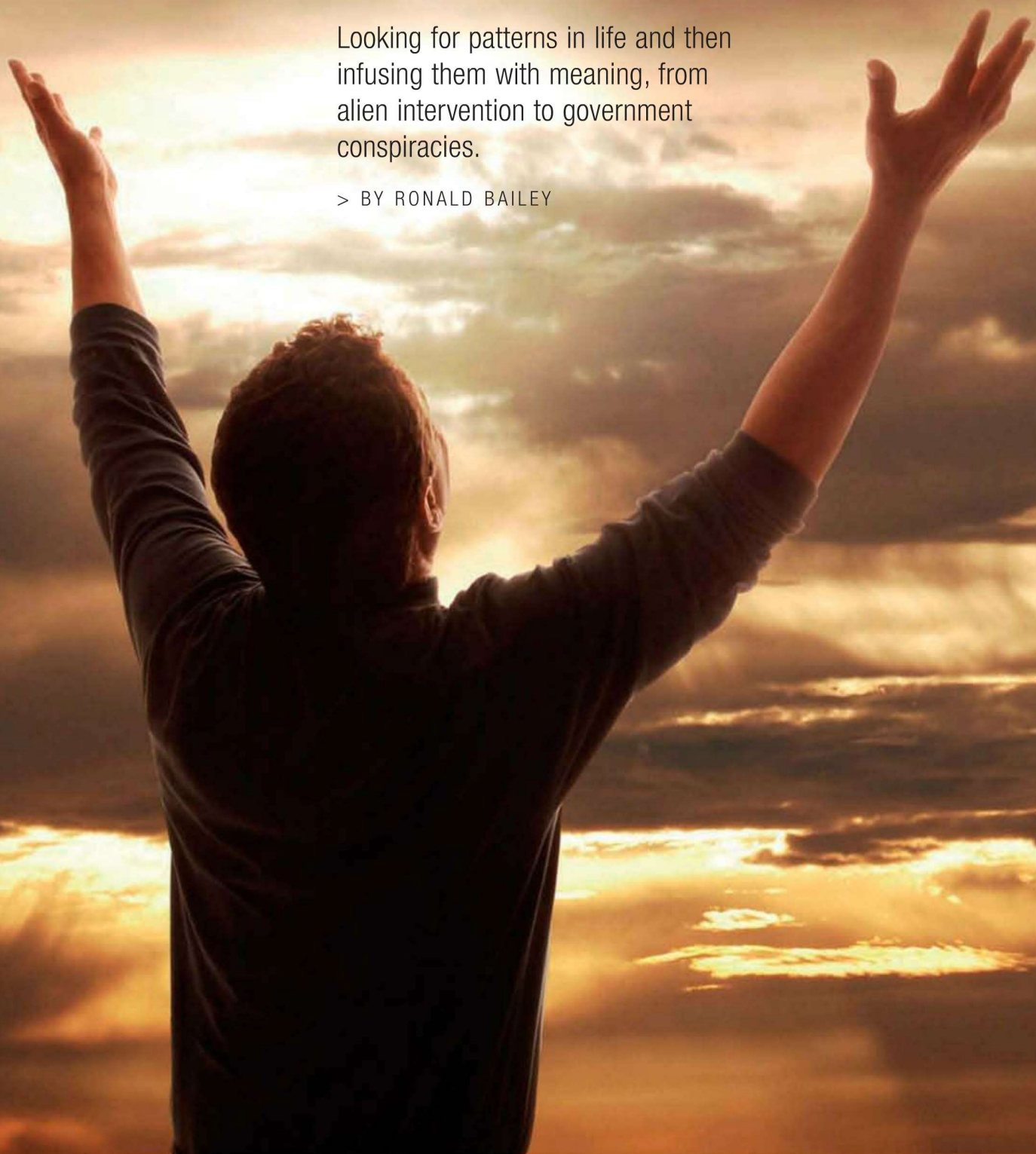
PM



A trick of the mind

Looking for patterns in life and then infusing them with meaning, from alien intervention to government conspiracies.

> BY RONALD BAILEY



Superstitions arise as the result of the spurious identification of patterns. Even pigeons are superstitious. In an experiment in which food is delivered randomly, pigeons will note what they were doing when the pellet arrived, such as twirling to the left and then pecking a button, and perform the manoeuvre over and over until the next pellet arrives. A pigeon rain dance.

This behaviour is not much different from the case of a baseball player who forgets to shave one morning, hits a home run a few hours later, then makes it a policy never to shave on game days. Beliefs come first; reasons second. That's the insightful message of *The Believing Brain*, a book by Michael Shermer, founder of *Skeptical* magazine.

In the book, he brilliantly lays out what modern cognitive research has to tell us



about his subject – namely, that our brains are “belief engines” that naturally “look for and find patterns” and then imbue them with meaning. These meaningful patterns form beliefs that shape our understanding of reality.

Our brains tend to seek out information that confirms our beliefs, ignoring information that contradicts them. Shermer calls this “belief-dependent reality”. The well-worn phrase, “seeing is believing”, has it backwards: in fact, our believing dictates what we’re seeing.

Shermer marshals an impressive array of evidence from game theory, neuroscience and evolutionary psychology. A human ancestor hears a rustle in the grass. Is it the wind or a lion? If he assumes it's the wind and the rustling turns out to be a lion, then he's not an ancestor any more. Since early man had only a split second to make such decisions,

Shermer says, we are descendants of ancestors whose “default position is to assume that all patterns are real; that is, assume that all rustles in the grass are dangerous predators and not the wind”.

In addition, as evolved social creatures, we have brains that are attuned to trying to discern the intentions of others – and we look for patterns, there, too, then try to infuse them with human intention and meaning, or what Shermer calls “agenticity”. Patterns in life are variously ascribed to the work of ghosts, gods, demons, angels, aliens, intelligent designers and government conspirators. “Even belief that the government can impose top-down measures to rescue the economy is a form of agenticity,” the author says.

Shermer also delves into the neuroscience of “the believing brain”. For example, he cites research suggesting that people with high levels of the feel-good neurochemical dopamine “are more likely to find significance in coincidences and pick out meaning and patterns where there are none”. Even for people with normal chemical levels, there's a neurological upside to pattern-finding: when we come across information that confirms what

‘We can safely say that, over the past ten thousand years of history, humans have created about ten thousand different religions and about one thousand gods’

we already believe, we get a rewarding jolt of dopamine.

The Believing Brain perhaps inevitably turns to religion, but a sign of Shermer's all-purpose scepticism is his consigning of the chapter “Belief in God”, along with “Belief in Aliens”, to a section called “Belief in Things Unseen”. He doesn't take religious faith seriously except as an object for explanatory debunking – God is simply the human explanation for pattern-making and agency on an epic scale.

“As a back-of-the-envelope calculation within an order-of-magnitude accuracy, we can safely say that over the past ten thousand years of history, humans have created about ten thousand different religions and about one thousand gods,” Shermer writes. He lists more than a dozen gods, from Amon Ra to Zeus, and wonders how one of them can be true and the rest false. “As sceptics like to say, every-

one is an atheist about these gods; some of us just go one god further.”

Readers who have enjoyed Shermer's earlier books, such as *Why People Believe Weird Things*, will relish the pages devoted to puncturing many of the conspiracy beliefs that lurk in our popular culture, from those about UFO cover-ups to the 9/11-was-an-inside-job lunacy. He also recounts, apparently not for the first time, his own supposed alien-abduction experience.

In 1983, competing in the Race Across America bicycle challenge, he rode 2 026 km in 83 hours without sleep and became delirious with exhaustion. When his support crew finally intervened to make him stop and get some rest, he became convinced that they were aliens forcing him into a mother craft – the interior of the UFO, it turned out, looked “remarkably like a GMC motor home”. A good long nap cured him of his delusion.

One of the book's most enjoyable discussions concerns the politics of belief. Shermer takes an entertaining look at academic research claiming to prove that conservative beliefs largely result from psychopathologies. He drolly cites survey results showing that 80 per cent of professors in the humanities and social sciences describe themselves as liberals. Could these findings about psychopathological conservative political beliefs possibly be the result of the researchers' confirmation bias?

As for his own political bias, Shermer says that he's a “fiscally conservative civil libertarian”. He is a fan of old-style liberalism, as in liberality of outlook, and cites *The Science of Liberty* author Timothy Ferris's splendid formulation: “Liberalism and science are methods, not ideologies.” The “scientific solution to the political problem of oppressive governments”, Shermer says, “is the tried-and-true method of spreading liberal democracy and market capitalism through the open exchange of information, products and services across porous economic borders”.

But it is science itself that Shermer most heartily embraces. *The Believing Brain* ends with an engaging history of astronomy that illustrates how the scientific method developed as the only reliable way for us to discover true patterns and true agents at work. Seeing through a telescope, it seems, is believing of the best kind.

● First published in *The Wall Street Journal*.

DIY HOME

> BY ROY BERENDSOHN

Q+A

BIG ideas for small BATHROOMS



Q We have two bathrooms in our house, and I want to fix up the smaller one. We use it infrequently, but I still want it to look nice. I think the first thing that needs to be changed is the basin, which is original to the house and almost 30 years old. The bath is also original, but we changed the toilet about 10 years ago. Can you do an article on how to swap a basin, or at least provide us some tips?

A The basin sets the stage in a small bathroom. It's the first thing you see as you step through the door, and because the room is small, the basin assumes outsized importance in the room's function and aesthetics alike. It can also take quite a beating, so it's not unusual to see it chipped, stained or scratched. I think you're making the right move. Swapping it will transform the room.

In terms of difficulty, on a scale of one to 10, I'd rate the swap at about a five if the new and old basin are similar and if they take a nearly identical mounting bracket or hanger. That five can easily increase to a six or seven if the new sink is larger or shaped differently than the original or if it requires an unusual mounting bracket. Worst case, the seven increases to an eight or nine if the wall is tiled and you learn that the old sink was barely hanging on the wall, in which case you could be looking at tile removal and reinforcement of the wall so you can affix the hanger/s. At that point, you might seriously consider an all-out bathroom remodelling job.

Regardless, the first step is finding a basin that you like and, if possible, obtaining special installation instructions if required.

In the "five" version of the job, you install the new mounting bracket/s per the manufacturer's instructions. On the basin, you mount the tap and supply lines, tailpiece and pop-up assembly. Then hang the basin. Down below, you connect the basin tailpiece to the trap and connect the trap to the trap arm that comes out of the wall. Connect the supply lines to the tap at the shutoff valves, where fitted. The "seven" or "eight" version of the job calls for all this plus tile removal, wall cutting, carpentry (drywall version), bricklaying and plastering, careful measuring, trial mounting – a lot of mess and fuss. It's not mechanically difficult, but it is time-consuming. Expect two to three full days of work to get the job done right.

THE GARAGE GAP

Q A space has formed where the edge of my garage floor meets the concrete driveway. Do I fill it in with concrete?

iStockphoto/John Cave

Remember to clean the concrete surface before applying the backer rod and sealant. This helps the sealant bond tenaciously to the concrete. Use a biodegradable cleaner such as Cleen Green and scrub the area with a deck brush on a pole. Rinse the area, then let it dry.

A new breed of contractor is springing up to address these problems. Known as building performance contractors, they specialise in improving how a structure uses energy. Their work starts with a thorough inspection to determine where heat or inside air is escaping. Then they make recommendations about how to improve the problem, or they do the remedial work themselves. Aside from making the house

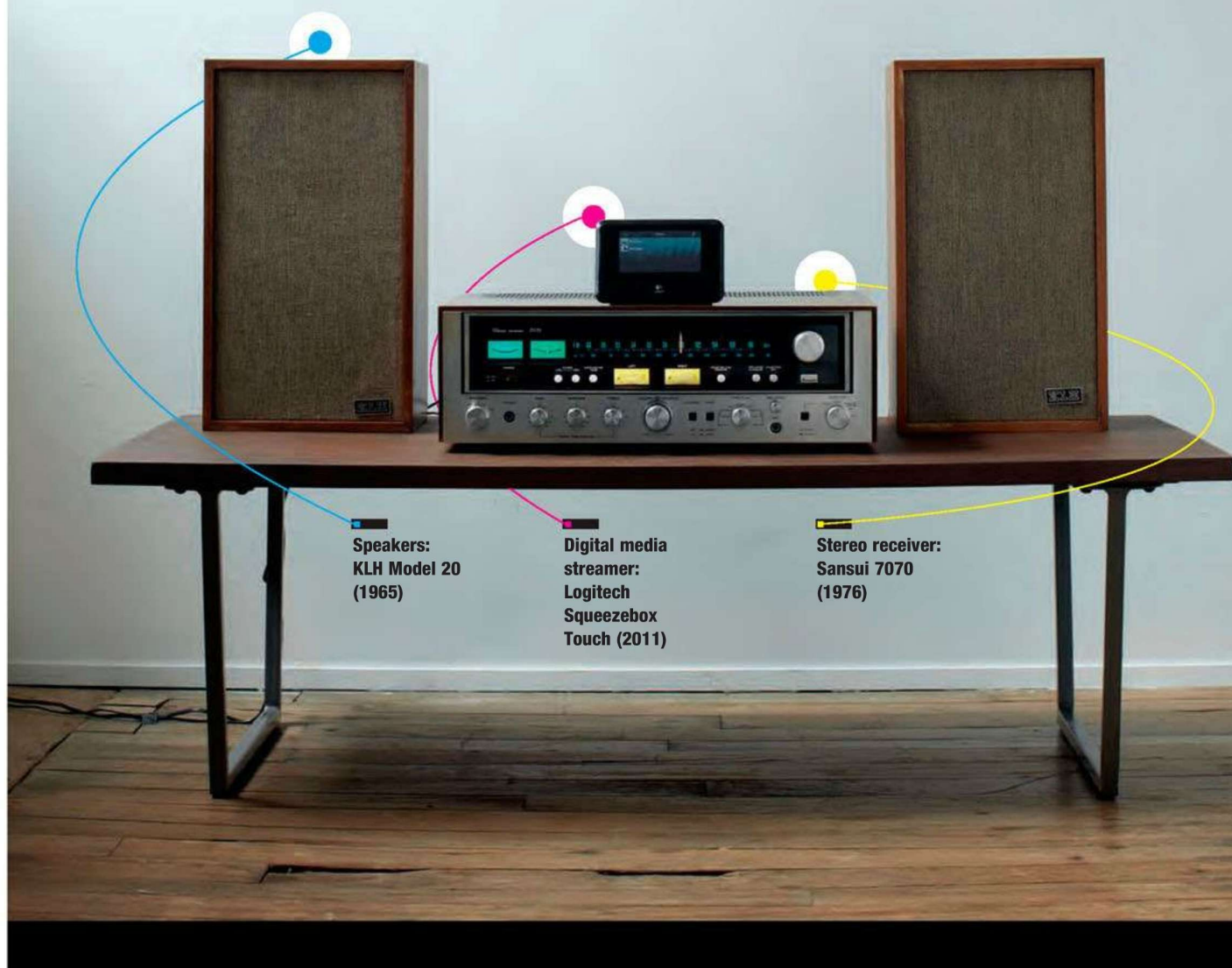
These tests are expensive, as are repairs, air sealing and improved insulation. But that cost is paid back in lower heating and cooling bills, and the house will be less draughty.

Driven by **Powertech** 

Vintage audio in the digital age

Don't ditch that hi-fi! Marry your digital music collection with your analogue audio gear.

> BY MARK WILSON



Seth Moot

➔ **There was a time** when we shared music through walls rather than social networks, when we prized the tactility of knobs and dials over the numb stroke of a thumb on a touchscreen. Electronics weren't disposable, and we understood that newer didn't always mean better.

The '70s were important years for the audio world, and they left a lasting legacy. Today, vintage audio equipment is anything but rare. Ageing speakers and receivers fill lofts and garages, or sit decoratively and underutilised in living room corners. They're fixtures at garage sales and second-hand shops, yet they are also the rare type of tech product that gets passed from generation to generation.

This isn't just about nostalgia – vintage audio equipment simply ages well. Many older receivers and speakers still produce remarkable sound – often better than the overamplified, undertuned, all-in-one 5.1 surround-sound systems that have come to dominate the home audio aisle – and they're certainly more attractive than some of their modern counterparts.

One problem: our music collections are increasingly digital – iTunes downloads, MP3s and streaming services – while vintage audio equipment is decidedly, and even proudly, analogue. Here's how to bridge the gap, bringing your classic audio equipment into the Internet age.

The good old gear

In terms of stereo equipment, the late '60s and the 1970s were a golden age. As Japan's tech giants lusted after the American hardware market, companies such as Kenwood/Trio, Pioneer, Yamaha and Sansui overbuilt and underpriced their receivers to get a piece of the action. This is a boon to music lovers today, as it was 40 years ago: if you don't happen to have a pile of audio equipment in storage, acquiring some is appealingly cheap.

"Those things are phenomenal," says *Stereophile* senior contributing editor Michael Fremer. "They sound so good, and you can pick one up for \$20 or \$30." South African prices may not be quite as favourable, but there's no question that these Far Eastern bargains can be had for the audio equivalent of small change – prices as low as a few hundred rand are not unusual. Pitted against today's home audio gear, a classic Kenwood receiver, for example, fares remarkably well, driving a full, powerful and variously adjustable sound.

And then there's the design. Vintage

audio equipment often looks as beautiful as it sounds; certainly more appealing than the plain plastic and sheet metal aesthetic adopted by so many modern electronics manufacturers (See "Best of British"). Stained wood, brushed aluminum and glass are par for the course in '60s- and '70s-era gear. Control panels glow in soft orange, blue and green hues, and needles bounce with the music. It's a distinctly high-end look, available for a bargain-basement price, if not for free – thanks, Dad!

The way of the wire

Getting this older gear to play your modern music isn't as hard as you might imagine. The simplest way to bridge the digital-to-analogue gap is the commonplace analogue connection standard that was popularised in the 1950s – the humble RCA plug. Stereo RCA cables are identified by their red and white connectors, but the basic RCA plug format, with its rounded post and stamped metal sheath, is also the interface for everything from phono-graph (turntable) connections to modern component video.

Since RCA has been a standard for more than half a century, virtually every digital plug manifestation has been forced to play nicely with it, so you can buy adapter cables to bridge a 3,5-mm mini headphone jack to RCA cheaply at nearly any electronics store. Technically, this is an analogue-to-analogue connection, so it's virtually foolproof.

If your music source doesn't have a spare 3,5-mm jack, there are adapter options for most common plug types. Online retailers such as Monoprice carry affordable adapters that convert Apple's 30-pin port to RCA (for iPods, iPhones and iPads), USB to RCA digital-to-analogue converters (for computers) and mini/micro USB to RCA converters (for Android phones and tablets), which will let you plug your digital audio devices into any receiver.

If you're willing to invest a bit more for a higher-quality link between your computer and receiver, a dedicated digital-to-analogue converter can bypass your computer's soundcard to produce a cleaner source audio signal. The low-end soundcards included in many com-

HEARING LOSS



UNDERSTANDING AUDIO COMPRESSION

A LOSSLESS AUDIO
The first image represents 10 seconds of Elvis Costello's "You Belong to Me", recorded in FLAC lossless audio format, which audiophiles swear by. The file is completely faithful to the source material, but it takes up 25,6 MB of space.

B TYPICAL MP3
The second image represents the same 10 seconds compressed into MP3 format at a quality of 192 kilobits per second – about what you get from a service such as iTunes. Sound quality is acceptable, and the song takes up just 3,5 MB of space.

C THE DIFFERENCE
To create the third clip, we've subtracted the MP3's sound data from the lossless file's sound data (directions at jax184.com). The resulting clip is a full representation of what audio was lost to compression. Played back on its own, it sounds hollow and distant, but still like the song.



puters, especially laptops, are prone to interference and noise. Digital-to-analogue converters skip over your PC's sound processor by receiving a raw digital audio signal over USB. Products such as the HRT Music Streamer II or NuForce Icon uDAC-2 are good bets.

Over the air

Plugging your digital source directly into your receiver is simple and cheap, but it's useless if your receiver is far from your music source. There are several wireless technologies that can act as a bridge between, say, a desktop in an office and the receiver in the living room. Wireless interfaces also make it easier to control your music – you can keep your iPod or smartphone in your pocket and play party DJ from any room in the house.

Assuming that you use a lot of Apple iOS devices, the AirPlay standard is likely your best bet. An Apple AirPort Express or AppleTV can serve as a wireless digital-to-analogue converter, receiving a Wi-Fi stream of music directly from your device – be it an iPhone or a laptop – and sending it to your receiver via a 3,5-mm jack. (This will require the aforementioned 3,5-mm-to-RCA adapter.)

You can also send your music from your computer to your iPod, iPad or iPhone by using a clever program called Airfoil (about R175, PC and Mac). This turns your iDevice into the audio interface, while you stream from the endless catalogue of music on your main machine.

If you have a catalogue of tracks on a Windows PC, you can stream music through a Windows Media Extender with analogue output capability, the most popular of which, by a long shot, is the Xbox 360. You can stream to an Xbox from a Mac too, but it will require some third-party software such as Nullriver's Connect360 (about R150).

Neither the AirPort Express nor the Xbox 360, however, is specifically an audio device. The AirPort is a wireless hotspot first, and a music streamer second; likewise, the Xbox 360 is a game console that just happens to be an excellent music device. If your only goal is to stream music from a computer to a stereo system, and particularly if you would like to connect your digital music collection to multiple receivers, the simplest option is an ingenious little product called the Orb MP-1 (R1 500).

This 8-cm discus-like device serves one purpose: to receive audio via Wi-Fi, and to pass it along to a 3,5-mm audio jack. It's small enough to hide behind a receiver or speaker, and cheap enough that a house-wide deployment – one for the system in the living room, one for the kitchen and one for the bathroom – won't break the bank. The Orb comes with software that makes sending tunes from one side of the house to the other as simple as clicking on an icon in the free Orb Caster desktop app (PC or Mac), or using one of the accompanying smartphone apps, available for both iOS and Android.

But none of these solutions will impress true audiophiles, since none of them supports FLAC, the de facto uncompressed digital audio format. FLAC offers greater clarity and quality than most MP3s and downloaded music, and if you've amassed a digital collection of lossless music that you'd like to wirelessly connect to your stereo system, you'll need a streaming device that supports it. The Logitech Squeezebox Touch (typically about R3 000) isn't cheap, but it builds a sturdy wireless bridge between your FLAC library and your receiver, and includes support for Internet radio, as well as streaming music services. **PM**



Best of British BY ANTHONY DOMAN

Just recently, I wrote to the South African distributors of Marantz* audio products remarking on the faithful (and continuing) service from my CD42 compact disc player. It's the youngest member of my home audio set-up in almost daily use, and the only one bought new – in Singapore in 1992.

The rest is unashamedly second-hand and uniformly classic-era. Some of it dates back to the 1960s. All of it has been acquired through browsing the classifieds, visiting flea markets and the occasional auction sale, and through buying or gratefully receiving castoffs from friends.

Living in the US in the 1970s acquainted me with leading American names – specifically speaker makes – such as AR, Bose and Advent. However, by the time I was able to start putting together a system back in South Africa, I had fallen under the spell of the 1980s British invasion.

In particular, I like the understated style and industrial-strength build of the Quad range (above). Over the years, I have accumulated a few of the amplifiers, both solid state and valve. The classic Quad 33/303 preamplifier/amplifier combination is worth considering; it regularly comes up at prices ranging from R1 500 to R3 000. Worthwhile (though not essential) upgrades to this setup entail a few minutes of soldering: new power supply filter capacitors and two pairs of resistors to improve CD replay. The one drawback of Quad equipment is that it uses DIN inputs, which can be tricky to source, so ensure you get all the relevant connecting leads.

Elderly speakers may stand the test of time less well, both through abuse and through ageing of components such as drive unit surrounds. Fortunately, superior materials have kept my B&W DM2a speakers from the 1970s competitive with current designs, though in fairness they were high-end models when new. Like many older designs, they are gigantic by modern standards. Unless you can find the equivalent for a lot less than the typical asking price of R1 000 to R3 000, you might be better off buying new.

My similar-era Linn Sondek LP12 turntable, sourced via Gumtree, is British, although the manufacturer might prefer to be called Scottish. Older models can cost as little as R1 500, but newer ones with the many upgrades on offer head north of R5 000 rapidly.

* Marantz is, of course, Japanese, though American Saul Marantz established the brand before being taken over by Dutch giant Philips and subsequently Marantz Japan.

IDC – a new path to development

Since 1940, the Industrial Development Corporation, South Africa's largest development finance institution, has helped to build the industrial capacity that fuels the country's economic growth, by funding viable businesses.

As the government's key partner in revitalising the economy, the IDC focuses on priority economic sectors that offer the greatest potential to unlock job opportunities.

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To be the primary driving force of commercially sustainable industrial development and innovation to the benefit of South Africa and the rest of the African continent.

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The Industrial Development Corporation is a national development institution whose primary objectives are to contribute to the generation of balanced, sustainable economic growth in Africa and to the economic empowerment of the South African population, thereby promoting the economic prosperity of all citizens. The IDC achieves this by promoting entrepreneurship through the building of competitive industries and enterprises based on sound business principles.

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Special **funding schemes** are available that address transformation and entrepreneurial development (TES); topping up equity contributions from entrepreneurs (TES & RCF); and sector-specific schemes (horticulture, forestry, clothing and textiles, hospitals). The IDC Gro-e-Scheme provides funding for projects from R1 million to R1 billion at prime less 3% for up to five years.

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If you have a project that can contribute to building South Africa's industrial capacity and creating jobs, visit www.idc.co.za to find out how the IDC can help build your opportunity.

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Pulse of a SUPERCAR

PM EDITOR ALAN DUGGAN WAS PART OF A SMALL GROUP OF SOUTH AFRICAN JOURNALISTS INVITED TO DRIVE MCLAREN AUTOMOTIVE'S RECORD-BUSTING MP4-12C SUPERCAR ON ITS HOME TEST TRACK AT DUNSFOLD PARK AERODROME IN ENGLAND. TO SAY THAT HE WAS IMPRESSED WOULD BE LIKE DESCRIBING SHAKIRA'S HIPS AS 'OKAY'.



PRETERNATURALLY SERENE, apparently oblivious to the squeal of tortured rubber and the sheen of perspiration coating my forehead, the test driver raised his voice above the McLaren's glorious baritone: "Relax... let the car do the work for you." So I did, and it did, and what came next was a trip to automotive nirvana.

Can you fall completely and irrevocably in love within the space of a single autumn afternoon? Do purple prose and shameless hyperbole belong in a car review? If we're talking about a palpably sexy amalgam of carbon, aluminium, electronic wizardry and engineering genius – plus the kind of performance that elevates pulse rates to beyond critical – then we would have to say yes.

Meet the McLaren MP4-12C, a race-bred sports-car that promises to revolutionise the industry and shake up some very respectable marques indeed. By all accounts, its major competitor is the formidable Ferrari 458 Italia, a car boasting an even more impressive heritage – and therein lies the challenge for McLaren Automotive, a new company with deep pockets and large goolies.

South African Greg Levine, the company's amiable sales and marketing director, says the 12C represents the first step in a programme that will see the introduction of a new high-performance sportscar every year. This is not just big talk: in 2011 alone, McLaren Automotive not only torture-tested, refined and launched its 12C, but also established the first retail outlets in a planned global network of 35, opened an impressive manufacturing facility, and launched a new GT team. They expect to roll out 2 000 cars in 2012, escalating this to 4 000 units by the middle of the decade. As Levine says: "The 12C will not be a one-hit wonder."

Probably the most significant component of the 12C's chassis is the MonoCell, a one-piece resin transfer-moulded carbon fibre tub weighing just 75 kg. Hollow and immensely strong, it forms the structural basis of the entire car, contributing to its low weight and overall efficiency. The MonoCell also provides the 12C with a high torsional stiffness-to-weight ratio, acting as a safety survival cell. Aluminium extrusions and castings are jig-welded into the finished assembly and bolted directly to the MonoCell.

Back to the adrenaline rush, and our afternoon with the McLaren MP4-12C.

For the uninitiated, Dunsfold Park is the track made famous by *that* trio of flamboyant British motoring journalists and their apparently mute test driver, a mysterious character who wears a white racing suit and has a penchant for self-help audio. We got to grips with the car on the figure-of-eight circuit while keeping a watchful eye for learner drivers and stray aircraft (it's a busy place, and half an hour before we first floored the gas pedal, the place was awash with L-plates).

Now let's talk numbers. The McLaren sprints from zero to 100 km/h in 3,3 seconds (or a blister-



ing 3,1 seconds with optional Corsa tyres). It covers the standing quarter-mile in 10,9 seconds and registers a top speed of 330 km/h. Stopping power? How about 100 km/h to standstill in just 30,5 metres?

In its debut Nürburgring Nordschleife media test earlier this year, *Sport Auto's* editor-in-chief Horst von Saurma-Jeltsch recorded a single-lap time of 7:28 in a production-spec 12C. In a flying lap, the 12C proved to be 10 seconds quicker around the "Green Hell" than the nearest Ferrari, and even faster than so-called "hyper-cars" from Koenigsegg and Pagani.



'Within a single lap, the tyres were squealing and the exhausts were howling a melody that only the initiated would understand.'

Power is provided by a 3,8-litre twin-turbo V8 engine designed by McLaren and built by Ricardo in Shoreham. Surprisingly light (it weighs just 199 kg) and extraordinarily powerful for its size, it churns out 441 kW at 7 000 r/min and 600 N.m of torque from 3 000 to 7 000 r/min. A flat-plane crankshaft allowed McLaren's engineers to place the engine low in the chassis and just behind the driver, lowering the car's centre of gravity and optimising its handling.

It's mated to a dual-clutch, seven-speed "SSG" transmission featuring three settings: Normal, Sport and Track modes. Each provides a progressive immediacy of gear shift, operated through fingertip controls mounted on a rocker behind the steering wheel: you upshift by pulling with the right hand or pushing with the left, and vice versa to downshift. It's very quick, swopping cogs several times faster than you can blink.

How does it feel behind the wheel? Amazingly comfortable. After squeezing into all too many sportscars with near-as-dammit fixed seats, offset pedals, tiny windows and the ergonomics of a playground swing, the McLaren was a revelation. The steering column is centred on

the driver, as are the brake and throttle pedals, and the low windscreen cowl provides six degrees of downward vision from eye height, allowing you to aim the car perfectly into a corner. You even have a good rear view, for heaven's sake.

Then there are the dihedral doors (first seen in McLaren's legendary F1), which allow driver and passenger to get into and out of the car with surprising ease. I may not have accomplished this exercise with dignity, but neither did I need to contort myself in such a way that I ended up with a surgical truss.

Having enjoyed a relatively leisurely drive along the tree-lined country roads of Surrey, interspersed with a couple of short bursts of acceleration (it's a boy thing), I returned to Dunsfold Park for a track outing under the tutelage of McLaren test driver Mat Jackson, a formidably talented British Touring Car racer who is not easily rattled. From that point on, it was pure adrenaline rush. Mat's calm voice led me through apexes, acceleration and braking points, warned me of hidden turns and rough surfaces, and generally equipped me with the information I needed to drive faster and better. Within a single lap, the tyres were squealing and the exhausts were howling a melody that only the initiated would understand.

Put simply, the McLaren handles like a dream. Much of the credit goes to its clever brake steer system, a variation on the electronic driver aid used with signal success on the MP4-12 Formula One car all of 14 years ago. It was subsequently banned, but has since been developed for the 12C as a control system to prevent wheelspin and improve traction.

In essence, it does the same job as a

"torque-vectoring" differential, using the same hardware as the 12C's electronic stability control (ESC) system to prevent wheelspin, reduce understeer and boost track times. It works by assessing the steering angle to determine the driver's intended course and applying the inside rear brake to increase the yaw rate and resume the desired course, effectively supporting a driver who has misjudged the corner (er... that would be me).

The ProActive chassis control system, based on double wishbones with coil springs and featuring adaptive damping,

provides much higher stiffness in roll compared with conventional suspension systems, as well as greater comfort in a straight line. The dampers are connected hydraulically and linked to a gas-filled accumulator, providing adaptive responses depending on road conditions and driver preference. You select Normal, Sport or Track settings through the Active Dynamics panel; each mode is responsible for managing roll control system pressure, adaptive damping and ESC settings.

My test drive completed, I handed over to Mat for what we agreed would be a "more vigorous" lap. This evolved into a three-lap chase of such vigour that my own telematics readout – handed to me later by the McLaren test team – resembled the perambulations of someone with a Zimmer frame. Whatever... I still had a ball.

McLaren's Greg Levine says he and his team have a shared vision: they look forward to the day when a gang of kids in a playground talk about the cars they want to own when they grow up, and – rather than citing Ferraris and Lamborghinis – speak wistfully of McLarens. They may not have long to wait.

PM



ON THE WEB > Visit www.popularmechanics.co.za to view a video of PM's editor in the adrenaline-pumping McLaren MP4-12C, and to read a blog on his experience. Also visit PM's Facebook page at www.popularmechanics.co.za/facebook for a photo album of this race-bred supercar, courtesy of McLaren Automotive.



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JUST THE FACTS

- The one-day PM Inventors Conference and awards dinner take place at the Indaba Hotel and Conference Centre in Fourways (Gauteng) on 24 November 2011.
- To book, follow the links on our Web site (www.popularmechanics.co.za).
- Only 100 seats are available for the Inventors Conference at a discounted cost of R800 each.
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- Further information is available from Nomfundo Calana on 021-530 3204; e-mail nomfundoc@ramsaymedia.co.za

You are cordially invited to book now for the third annual PM Inventors Conference, a unique event that brings together some of the country's sharpest minds for a full day of practical and inspiring presentations. (We would advise you to hurry: bookings close within a few days.) Some extracts from our programme:

- **Don MacRobert**, the highly respected intellectual property expert and co-author of the book, *From Edison to iPod*, will speak about some of the most pressing issues affecting today's inventors.
- **Brian Steinhobell**, the widely travelled and formidably talented industrial designer and product developer: Why good design rules the world.
- **Professor Deon de Beer**, executive director of Technology Transfer and Innovation at the Vaal University of Technology and founder of the Centre for Rapid Prototyping and Manufacturing (CRPM) at the Central University of Technology: DIY prototyping.
- **Simon Gear**, a director of Kijani Green Energy, expert in corporate sustainability and modern environmental thought, and anchor of South Africa's premier environmental TV show, *50/50*.
- **Errol Braithwaite**, Technical and Marketing Executive for Bombela – the company contracted to design, build and operate the Gautrain Rapid Rail Link: Building Gauteng's transport future.
- **Ravini Moodley**, CEO of the Institute of Inventors and Innovators (III): Bridging the innovation chasm.
- **Ivor Ichikowitz**, chairman of the Paramount Group, describes the gestation and birth of the revolutionary SA-designed AHRLAC, a reconnaissance aircraft with huge earnings potential: Why we sometimes need to think BIG.
- Inventor **Richard Kgwahla** and patent attorney **Anthony van Zantwijk** of Sibanda & Zantwijk: *How the "little guy" fought to take his ideas from concept to reality.*



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Space exploration

Mars or bust

As we went to press with this issue of PM, Nasa was preparing to launch a sophisticated rover that represents a major component of the agency's Mars Exploration Programme. The rover will assess whether the Martian environment ever was – or may still be – capable of supporting microbial life. In other words, its mission is to determine the planet's "habitability".

It's a question that has teased scientists, dreamers, fantasy writers – yes, and people like us – for centuries: is there, or has there ever been, life on Mars? In the coming year, a 900 kg Nasa-designed rover called Mars Science Laboratory will hopefully deliver a convincing answer. It's not about bug-eyed monsters, of course; what the scientists are looking for is the unmistakable footprint of microbial life, albeit unimaginably ancient.

To find out, the rover – dubbed *Curiosity* – will carry the biggest, most advanced suite of instruments for scientific studies ever sent to the Martian surface. It will analyse dozens of samples scooped from the soil and drilled from rocks. The record of the planet's climate and geology is essentially written in the rocks and soil – in their formation, structure and chemical composition. The rover's onboard laboratory will study rocks, soils and the local geologic setting in order to detect chemical building blocks of life (that is, forms of carbon) on Mars, and assess what the Martian environment was like in the past.

To do its job, the rover will rely on a variety of technological innovations, especially for the landing procedure. The spacecraft will descend on a parachute and then, during the final seconds prior to landing, lower the upright rover on a tether to the surface – much like a sky crane. Once on the surface, the rover will be able to roll over obstacles up to 75 cm high and travel up to 90 m per hour. On average, it is expected to travel about 30 m per hour, based on power levels, slippage, steepness of the terrain, visibility and other variables.

The rover will carry a radioisotope power system that generates electricity from the heat of plutonium's radioactive decay. This power source gives the mission an operating lifespan on Mars' surface of a full Martian year (that is, 687 Earth days) or more while also providing significantly greater mobility and operational flexibility, enhanced science payload capability, and exploration of a much larger range of latitudes and altitudes than was possible on previous missions to Mars.

Arriving at Mars in 2012, *Curiosity* will serve as an entrée to the next decade of Mars exploration. It represents a huge step in Mars surface science and exploration capability because it will demonstrate:

- The ability to land a very large, heavy rover on the surface of Mars (which could be used for a future Mars Sample Return mission that would collect rocks and soils and send them back to Earth for laboratory analysis).
- The ability to land more precisely in a 20 km landing circle.
- Long-range mobility on the surface of the red planet (5-20 km) for the collection of more diverse samples and studies.

Curiosity will assess whether Mars ever had an environment capable of supporting microbial life. Determining past habitability on Mars gives Nasa and the scientific community a better understanding of whether life could have existed on the Red Planet and, if it could have existed, an idea of where to look for it in the future.

If all goes according to plan, the mission will launch on 25 November.



takes a bold leap



Sharpshooter

A Russian-built, neutron-shooting instrument on *Curiosity* will check for water-bearing minerals in the ground beneath the rover. The instrument, named Dynamic Albedo of Neutrons, or DAN, has two major components: the pulsed neutron generator on the starboard side of the rover (indicated in the picture by red outline), and the detector and electronics module on the port side.

The generator will shoot high-energy neutrons into the ground. If there is hydrogen in the shallow subsurface, the injected neutrons will bounce off the hydrogen atoms with a characteristic decrease in energy. Two detection devices in the detector and electronics module measure the rate and delay time of the reflected neutrons, yielding information about the amount and depth of any hydrogen. At the mission's near-equatorial landing area and in the oxidising environment near the Martian surface, most hydrogen is expected to be in the form of water molecules or water-derived hydroxyl ions bound to minerals.

It's about brains, stupid

The rover's computers (*aka* brains) are located inside a module called the Rover Compute Element (RCE), and are composed of equipment comparable to a high-end laptop computer. They feature a special memory to tolerate the extreme radiation environment from space and to safeguard against power-off cycles, so the

programs and data will not accidentally be erased when the rover shuts down at night.

Onboard memory is roughly eight times better than the computer aboard the twin Mars Exploration Rovers (which, by the way, performed magnificently over a period of several years). The latest rover also carries an inertial measurement unit that provides 3-axis information on its position, which enables the rover to make precise vertical, horizontal and side-to-side (yaw) movements. The device is used to support safe traverses and to estimate the degree of tilt the rover is experiencing on the surface of Mars.

One of the rover's two brains remains asleep, being awakened only if the first brain experiences problems. Just like the human brain, the rover computers monitor its "health", temperature and other features. This main control loop essentially keeps the rover alive by constantly checking itself to ensure that it is both able to communicate throughout the surface mission and that it remains thermally stable (that is, not too hot or too cold) at all times. It does so by periodically checking temperatures, particularly in the rover body, and responding to potential overheating conditions, recording power generation and power storage data throughout the Mars sol (Martian day), and scheduling and preparing for communication sessions.

SpaceX takes on the world

Much of the buzz in the corridors of Cape Town's International Convention Centre in early October was focused on the development of commercial space flight. This was hardly surprising, given the presence of some 2 000-plus delegates attending the 62nd International Astronautical Congress, but what we found interesting were the frequent references to "affordability". This leads rather neatly to an impassioned statement issued earlier this year by **Elon Musk**, the South African-born engineer and entrepreneur who founded SpaceX (Space Exploration technologies) in 2002. It's worth repeating here...

"Whenever someone proposes to do something that has never been done before, there will always be sceptics. So when I started SpaceX, it was not surprising when people said we wouldn't succeed. But now that we've successfully proven Falcon 1, Falcon 9 and Dragon, there's been a steady stream of misinformation and doubt expressed about SpaceX's actual launch costs and prices. As noted... by a Chinese government official, SpaceX currently has the best launch prices in the world, and they don't believe they can beat them. This is a clear case of American innovation trumping lower overseas labour rates.

"I recognise that our prices shatter the historical cost models of government-led developments, but these prices are not arbitrary, premised on capturing a dominant share of the market, or 'teaser' rates meant to lure in an eager market, only to be increased later. These prices are based on known costs and a demonstrated track record, and they exemplify the potential of America's commercial space industry.

"Here are the facts:

The price of a standard flight on a Falcon 9 rocket is \$54 million (*about R425 million; correct at the time of going to press – Editor*). We are the only launch company that publicly posts this information on our Web site. We have signed many legally binding contracts with both government and commercial customers for this price (or less). Because SpaceX is so vertically integrated, we know and can control the overwhelming majority of our costs. This is why I am so confident that our performance will increase and our prices will decline over time, as is the case with every other technology.

"The average price of a full-up Nasa Dragon cargo mission to the International Space Station is \$133 million, including inflation, or roughly \$115 million in today's dollars, and we have a firm, fixed price contract with Nasa for 12 missions. This price includes the costs of the Falcon 9 launch, the Dragon spacecraft, all operations,



maintenance and overhead, and all of the work required to integrate with the Space Station. If there are cost overruns, SpaceX will cover the difference. (This concept may be foreign to some traditional government space contractors that seem to believe that cost overruns should be the responsibility of the taxpayer.)

"The total company expenditures since being founded in 2002 through the 2010 fiscal year were less than \$800 million, which includes all the development costs for the Falcon 1, Falcon 9 and Dragon. Included in this \$800 million are the costs of building launch sites at Vandenberg, Cape Canaveral and Kwajalein, as well as the corporate manufacturing facility that can support up to 12 Falcon 9 and Dragon missions per year. This total also includes the cost of five flights of Falcon 1, two flights of Falcon 9, and one up and back flight of Dragon.

"The Falcon 9 launch vehicle

was developed from a blank sheet to first launch in four and half years for just over \$300 million. The Falcon 9 is an EELV class vehicle that generates roughly one million pounds of thrust (four times

the maximum thrust of a Boeing 747) and carries more payload to orbit than a Delta IV Medium.

"The Dragon spacecraft was developed from a blank sheet to the first demonstration flight in just over four years for about \$300 million. The spacecraft and the Falcon 9 rocket that carried it were designed, manufactured and launched by American workers for an American company. The Falcon 9/ Dragon system, with the addition of a launch escape system, seats and upgraded life support, can carry seven astronauts to orbit – more than double the capacity of the Russian Soyuz, but at less than a third of the price per seat.

"SpaceX has been profitable every year since 2007, despite dramatic employee growth and major infrastructure and operations investments. We have over 40 flights on manifest representing over \$3 billion in revenues.

"These are the objective facts, confirmed by external auditors. Moreover, SpaceX intends to make far more dramatic reductions in price in the long term when full launch vehicle reusability is achieved. We will not be satisfied with our progress until we have achieved this long-sought goal of the space industry.

"For the first time in more than three decades, America last year began taking back international market share in commercial satellite launch. This remarkable turnaround was sparked by a small investment NASA made in SpaceX in 2006 as part of the Commercial Orbital Transportation Services (COTS) programme. A unique public-private partnership, COTS has proven that under the right conditions, a properly incentivised contractor – even an all-American one – can develop extremely complex systems on rapid timelines and a fixed-price basis, significantly beating historical industry-standard costs.

"China has the fastest-growing economy in the world. But the American free enterprise system, which allows anyone with a better mousetrap to compete, is what will ensure that the United States remains the world's greatest superpower of innovation." – ELON MUSK

● Also see PM Breakthrough Awards, "Launching private spaceflight".

"intellectuals
solve problems,
geniuses
prevent them."

albert einstein

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level 3 BBBEE: AA rating

Amateur astronomers watch our backs

For the first time, observations co-ordinated by the European Space Agency's space hazards team have found an asteroid that comes close enough to Earth to pose an impact threat. The space rock was found by amateur astronomers, highlighting the value of "crowd-sourcing" to science and planetary defence. The discovery of asteroid 2011 SF108 was made by the volunteer Teide Observatory Tenerife Asteroid Survey (TOTAS) team during a four-night survey using the 1 m-aperture telescope on Tenerife in the Canary Islands. During their observations, the

telescope runs automated asteroid surveys for several hours, using specially developed software. However, potential sightings must still be evaluated by humans.

As with so many things space-related, however, 'impact threats' are relative. The orbit of asteroid 2011 SF108, for example, brings it no closer to earth than about 30 million kilometres – considered a safe distance. The object is the 46th asteroid discovered by Rainer Kracht, a retired schoolteacher who lives in Elmshorn, Germany. "Eight of us reviewed images on the night of

the discovery, and I was lucky to be the one who found 2011 SF108 as part of this team," says Kracht.

To date, some 8 000 near-Earth objects have been discovered worldwide. Many thousands more are thought to exist, particularly in the size range of metres to hundreds of metres. Scientists say it is important to find and track these to determine if any pose an impact threat to Earth.

● Source: ESA

PM



Above: The European Space Agency's Optical Ground Station in Tenerife, Spain. The telescope was originally built for tests with laser links, and for space debris observations. Left: Astronomers at work in the control room. Left: The control room at ESA's Optical Ground Station in Tenerife, Spain.

Pictures: ESA

Water, water, everywhere

Using data from the Herschel Space Observatory, astronomers have detected cold water vapour enveloping a dusty disc around a young star. Their findings indicate that this disc, which is poised to develop into a solar system, contains great quantities of water, suggesting that water-covered planets like Earth may be common in the Universe.

Evidence for vast quantities of water extending out into the cooler, far reaches of discs where comets take shape had not been seen until now. The more water available in discs for icy comets to form, the greater the chances that large amounts eventually will reach new planets through impacts.

Says astronomer Michiel Hogerheijde of Leiden Observatory in the Netherlands: "Our observations of this cold vapour indicate enough water exists in the disc to fill thousands of Earth oceans."

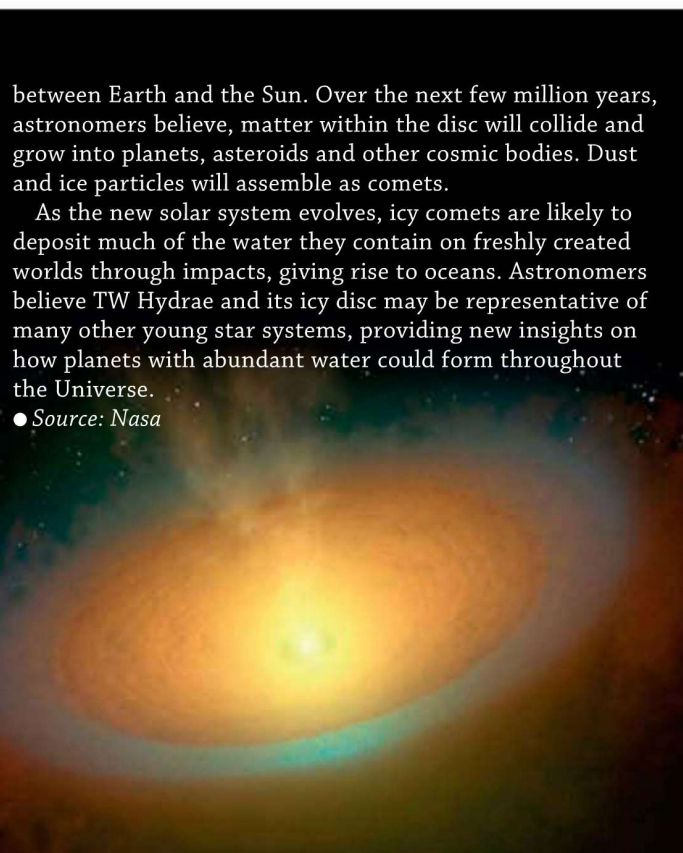
The star with this waterlogged disc, called TW Hydrae, is 10 million years old and located about 175 light-years away from Earth, in the constellation Hydra. The frigid, watery haze detected by Hogerheijde and his team is thought to originate from ice-coated grains of dust near the disc's surface. Ultraviolet light from the star causes some water molecules to break free of this ice, creating a thin layer of gas with a light signature detected by Herschel's Heterodyne Instrument for the Far-Infrared, or HIFI.

TW Hydrae is an orange dwarf star, somewhat smaller and cooler than our yellow-white sun. The giant disc of material that encircles it has a size nearly 200 times the distance

between Earth and the Sun. Over the next few million years, astronomers believe, matter within the disc will collide and grow into planets, asteroids and other cosmic bodies. Dust and ice particles will assemble as comets.

As the new solar system evolves, icy comets are likely to deposit much of the water they contain on freshly created worlds through impacts, giving rise to oceans. Astronomers believe TW Hydrae and its icy disc may be representative of many other young star systems, providing new insights on how planets with abundant water could form throughout the Universe.

● Source: Nasa



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SMS: Razor, followed by the answer, your name and e-mail address to 32697 (R1,50 per SMS) or visit our Web site at www.popularmechanics.co.za. Competition closes 31 December 2011.

Rules:

1. Entry is open to anyone except employees (and their immediate families) of RamsayMedia, Tevo and associated agencies. **2.** Only one online entry per person. You may enter via SMS as many times as you like (SMSs charged at R1,50). **3.** Competition runs until 31 December 2011. **4.** We will draw the winner(s) on 9 January 2011. **5.** The prize is not redeemable for cash. **6.** The judges' decision is final and no correspondence will be entered into. **7.** Regrettably, only South African residents are eligible for prizes. **8.** Prizes not claimed within 3 months will be forfeited.



Dirt Rocket MX350

Popular Mechanics
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CARmagazineSA

Playing it safe

Beef up your household and personal safety



WHAT CAN'T BE SEEN, CAN'T BE TAKEN

Hidden alcoves and secret passages have been around since humans acquired the concept of property ownership. The Pharaohs put a unique spin on asset retention (they opted for a post-mortem strategy that involved thousands of slaves and very large mausoleums), and for centuries, popes relied on a hidden passage when Rome came under siege. Heck, even cavemen probably hid their favourite stone tools.

What's really cool is that you can have your very own secret rooms or hidden passage. Whether it's a fun hideaway for the kids, a hidden vault for stashing your valuables or a place for your prized wine collection, Steve Humble of Creative Home Engineering is the man to call. But be warned, his expertise doesn't come cheap: a typical secret-room setup will probably set you back around R75 000, and if you want something really fancy – such as a rotating fireplace – you'll need to cough up a quarter of a million rand or more.

According to Humble, secret-passageway bookcases are the most popular requests. Dressers, complete with functional drawers, are great for kids' playrooms and in places where full-height door openings aren't required. Other popular concealment options include hinged pool cue racks, mirrors and paintings, wardrobes and even grandfather clocks. Says Humble: "Basically, if you can dream it, we can build it."

For more information, visit www.hiddenpassageway.com





STASH IT, DIY STYLE

If you're unwilling or unable to pay a professional to create a secret hiding place for your valuables, why not do the job yourself? After all, most homes have nooks and crannies that can be skilfully closed off and concealed; all that's required is a bit of DIY ingenuity.

Case in point: one PM reader, when building an extra room on to his home, created a hidden "safe" by sinking a 600 mm-diameter by 500 mm-deep glass fibre drum into the floor (before concreting it into position, he wrapped it in heavy building plastic to keep the damp out). When he threw the concrete slab, he left a small opening above the drum to provide access. The entire room was then tiled, and a piece of plywood was used to plug the hole. Once the carpet and couch were neatly in position, you'd never guess it was there.

Says our (anonymous) reader: "I have about eight hidey holes dotted around my house... some large enough for an adult to hide in, others just big enough to stash away small items such as passports and wallets."



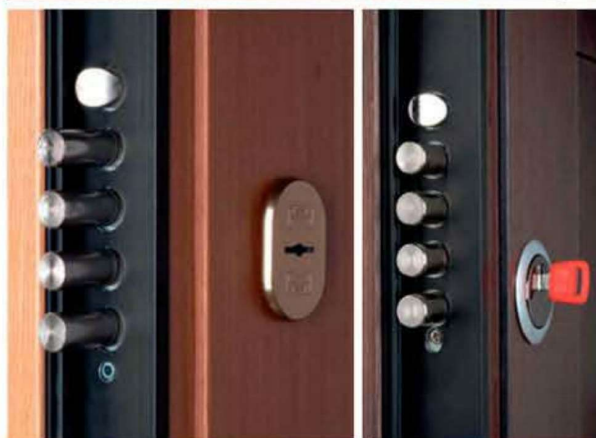
INTRUDER ALERT

There's nothing quite like a couple of large, vicious hounds to keep unwanted visitors at bay – that is, assuming you can wake them up to the fact that an intruder has entered the property. Small dogs, which reputedly have better hearing, are renowned for their ability to sound the alarm, but what if you're not a lapdog kind of guy?

Consider the situation of Milnerton resident Kevin Thorpe, owner of a formidable Rottweiler and Boerboel-cross guard dog duo. Deciding it would be silly to employ a small dog as an animated trigger for the serious muscle, he opted instead for a high-tech solution, linking infrared sensors he had already installed around his property to buzzers in the dogs' kennel.

Each buzzer emitted a different tone, which the dogs quickly learned to identify with a specific area or zone, enabling them to race to the right spot (and presumably eat the hapless intruder). Says Thorpe: "Because I always install spare conduits around my property when I tackle alterations, and the kennel was already equipped with mains power for its heater, this project was easy to rig up. I enjoy making up things that an intruder wouldn't think to look for."





DON'T PANIC, JUST HIDE

Few things can be more terrifying or traumatic than being accosted by armed intruders. Sadly, home invasions have become part of our urban reality – to the point where having a “safe room” – a secure place where your family can be protected until help arrives – is worth serious consideration.

“Our product is designed for use from the moment an intruder is detected or an alarm is triggered,” says Panic Room SA’s Grant Anderson. “Most homes in our target market are linked to an armed reaction service. The critical time therefore is the time between calling for help and help actually arriving. Industry standards vary on this respect, but a sub-five minute reaction time is unusual.”

Construction methods vary, from the conversion of a suitable area (such as a walk-in cupboard or bathroom) through to a purpose-designed room constructed when the house is built. However, a few critical components remain common to all. Among them: projectile-proof security doors capable of withstanding multiple attempts at forced entry (here we’re talking bullets, crowbars and other objects) and a CCTV/alarm system that enables the timeous detection of a home invasion.

Concrete floors are ideal and, depending on what ceiling you have in your home, security bars and “architectural armour” may need to be installed there, too. If the designated space has windows, then ballistic polycarbonate thermoplastic needs to be installed in place of (or in addition to) ordinary glass. The room should also be sound-proofed (so the intruders can’t hear you) and equipped with a covert surveillance system (so you can see what’s going on), communication equipment (allowing you to safely communicate with the authorities) and first aid kits (in case something goes seriously awry).

If you opt for a top-of-the-range installation, you get such features as air purification, an emergency power system and even dedicated plumbing. Prices vary, but you can expect an entry-level solution to set you back about R45 000.

For more information, contact Panic Room SA on 083 629 8698 or visit www.panicroom.co.za



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Touch tomorrow

DEGREE OF DIFFICULTY /// MODERATE



With the help of two certified mechanics, we've produced a 101-point used-car checklist that you can tear out of the magazine or download from popularmechanics.com/usedcarchecklist

How to INSPECT A USED CAR

DO YOUR DUE DILIGENCE AND YOU'LL REDUCE YOUR CHANCES OF GETTING BURNED BY A SECOND-HAND CAR.

> BY LARRY WEBSTER

Sooner or later most of us will buy a used car. Whether it's a cheap set of wheels for a student driver, a classic muscle car, a 4x4 for weekend getaways or simply a low-mileage alternative to a new car, the possibilities are endless. The trick to buying any previously owned car is to know what you're getting. And in the wild world of used cars, the only way to set your mind at ease before you buy is a thorough inspection. Sure, you can farm this out to an expert, but anyone with some mechanical experience can perform the task. You'll save a few bucks and add to your automotive knowledge. We're here to show you how to navigate your way through a sea of possible lemons.

THE ART OF THE INSPECTION

Before you do anything, check for an online community focused on the model you're going to inspect. Many cars, especially enthusiast favourites, have well-known trouble spots.

When you arrive on location, ask to see the car's registration papers. You'll want to be sure you are not buying a salvaged car, for instance – one that was totalled and fixed or flooded. (Unless the price is ridiculously low, treat salvaged cars like they're on fire: run.) Also ask for service receipts. A thorough service history indicates a properly maintained car and verifies the car's mileage.

Assuming the paperwork checks out, examine the car outside – natural light reveals more flaws. On more modern vehicles, use a scan tool – either rent one or equip a smartphone with the R700 GoPoint GL1 cable and app – to record any fault codes (an Internet search will reveal their meaning). Check for rusty areas and dented, crinkled or shiny metal. Rust is an obvious problem, but gouges along the underbody pinch welds suggest that the car has been on a frame-straightening machine. Small crash fixes don't necessarily fail a car, but you

don't want a vehicle that took a huge hit. Note any fluid leaks or puddles under the car. Fixing leaks can be easy and cheap, like replacing a valve-cover gasket, or in the case of a bad rear-main seal, complicated and expensive.

In the engine bay, check that all the fluid levels are within range. Note anything amiss, like bare, stray wires. Engines in modern cars are quite robust, provided they've been maintained. But it's a good idea to remove the dipstick and wipe it on a clean white rag. The oil should be brown. Milky oil suggests coolant in the sump; a petrol smell means worn piston rings. And if there are fine metallic particles mixed with the oil, the engine won't be running for long. Do the same fluid check for the transmission. Dark or metallic particles indicate worn parts.

Make sure you get behind the wheel. Workshop owner Steve Steeb relies mostly on the test drive to suss out a car's condition. Steeb drives on varied roads – some with bumps, others long and straight – and listens for any strange noises. He applies brakes during turns and drives up steep parking lot ramps.

He's not looking for specific flaws ("Worn brakes are easily fixed," he says), but rather, getting the general feel of the vehicle. Several things will immediately fail a car – a knocking noise from the engine, jerky transmission shifts, a slipping clutch or banging from the suspension – but Steeb is also trying to decide if it simply feels worn out. "Little things add up," he says. "Does the steering wheel jiggle, or does the car pull to one side when braking? Is the interior a cacophony of rattles? I tell folks to trust their intuition."

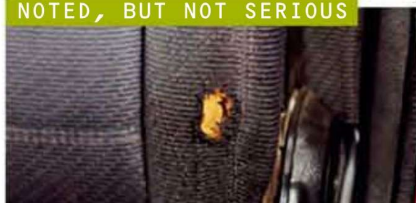
A few warts don't mean that a used car is a bad buy. Take a survey of the numerous online price guides and use that book value as a starting point. Employ the demerits you've compiled to negotiate. With any used car, expect the unexpected. "There's a lightning strike waiting in every older car," Steeb says. So leave a little in the budget to cover the inevitable unforeseen repair. But if you're detailed and diligent, you can minimise your chances of ending up with a clunker.

PM

WHAT TO WATCH OUT FOR

Any inspection checklist aims to help you, the buyer, eyeball the car completely. Often there isn't one obvious tell that the car is a basket case, but rather, several little things that, taken together, become revealing. Be thorough.

NOTED, BUT NOT SERIOUS



NO. 20: SEAT TEARS Unless the car is nearly new, expect some blemishes. Higher-mileage cars typically have wear marks in the interior, like torn driver-side bolsters.

CAUSE FOR CONCERN



NO. 13: THE MAGNET TEST Put a magnet on the sheet metal (use a rag to avoid marring the finish). If it fails to stick, there's a thick layer of filler under the paint from shoddy dent repair.

SERIOUS ISSUE



NO. 40: FLUID LEAKS It's hard to predict when a slow leak will turn major, and the cost to fix varies widely. Assume the worst.

DEAL BREAKER



NO. 62: OIL SEASONED WITH METAL FLAKES Shiny particles in the oil mean the engine is tearing itself up. DEFCON 1.

How to use the checklist

Mark your answers and then tally the totals for each category. Use the scorecard at the end as a guide to determine the car's overall condition.



USED-CAR CHECKLIST

Popular Mechanics

TOOLS TO BRING



Flashlight



Jack



Jackstands



Code reader



Clean, white rags



Magnet

MAKE

MILEAGE

MODEL

VIN

YEAR

ASKING PRICE

SCAN-TOOL CODES (IF ANY)

KEY



Noted, but
not serious



Cause for
concern



Serious
issue

DEAL BREAKER

Flee the premises.

THE BASICS

- | | Yes | No |
|---|--------------------------|--------------------------|
| 1 Is the owner's manual missing? | ☐ | ☐ |
| 2 Are there large gaps in the service history or no records at all? | ☐ | ☐ |
| 3 Do you suspect the mileage isn't legitimate? | ☐ | ☐ |

DEAL BREAKER

- | | | |
|--|--------------------------|--------------------------|
| 4 Does the title include the word "salvage"? | ☐ | ☐ |
|--|--------------------------|--------------------------|

EXTERIOR

- | | | |
|---|--------------------------|--------------------------|
| 5 Is there evidence of kerb damage on the wheels? | ☐ | ☐ |
| 6 Are the windscreen wiper blades damaged? | ☐ | ☐ |
| 7 Are any hubcaps missing, damaged or loose? | ☐ | ☐ |
| 8 Are all the tyre pressures properly set? | ☐ | ☐ |
| 9 Is the paint faded or cracked? | ☐ | ☐ |
| 10 Are any panels a different shade or colour? | ☐ | ☐ |
| 11 Are any of the panel gaps markedly different than the others? | ☐ | ☐ |
| 12 Are any of the trim pieces loose or missing? | ☐ | ☐ |
| 13 Does a magnet fail to adhere to the sheet metal? (Try several spots.) | ☐ | ☐ |
| 14 Are any of the tyres a different brand or size? | ☐ | ☐ |
| 15 Is there evidence of accident damage that has been poorly repaired? | ☐ | ☐ |
| 16 Are lug nuts missing? | ☐ | ☐ |
| 17 Are there any small dark spots or oily film on the bumper near the exhaust pipe? | ☐ | ☐ |
| 18 Are there any small rust spots? | ☐ | ☐ |

DEAL BREAKER

- | | | |
|------------------------------|--------------------------|--------------------------|
| 19 Is there rust everywhere? | ☐ | ☐ |
|------------------------------|--------------------------|--------------------------|

INTERIOR

- | | | |
|---|--------------------------|--------------------------|
| 20 Are there any tears or wear marks in the seats? | ☐ | ☐ |
| 21 Are there any cracks, blemishes or broken trim? | ☐ | ☐ |
| 22 Are the spare tyre, jack and tools damaged or missing? | ☐ | ☐ |
| 23 Do any of the windows go down or up slower than the others? Do they make noises? | ☐ | ☐ |

- | | Yes | No |
|--|--------------------------|--------------------------|
| 24 When the climate control is turned on, does the fan squeak or rattle or operate on only one speed setting? | ☐ | ☐ |
| 25 Does the air conditioning blow warm air? | ☐ | ☐ |
| 26 Turn on all the accessories (windshield wipers, radio, power mirrors, etc.). Do any fail to operate properly? | ☐ | ☐ |
| 27 Is the brake pedal worn more or less than the mileage on the odometer would suggest? | ☐ | ☐ |
| 28 Is there any rust or evidence of water in the spare-tyre well? | ☐ | ☐ |
| 29 Does the sunroof operate slowly, as if it's struggling to move? | ☐ | ☐ |
| DEAL BREAKER | | |
| 30 Is there a stale smell, like mildew or spoiled milk? | ☐ | ☐ |
| 31 Is there evidence of water damage in the glovebox or under the rear seat? | ☐ | ☐ |

CHASSIS/UNDERBODY

- | | | |
|--|--------------------------|--------------------------|
| 32 Are any of the inner fender shields missing or broken? | ☐ | ☐ |
| 33 Put your knee on the bumper, bounce the car three times, then stop. Does the body move up and down more than two times? | ☐ | ☐ |
| 34 Is there uneven wear on any of the tyres? | ☐ | ☐ |
| 35 Does oil coat any of the shock absorbers? | ☐ | ☐ |
| 36 Jack up the car and safely support it so the wheels are off the ground. Tug and push on the wheels. Is there any lateral play at the hub? | ☐ | ☐ |
| 37 Pull on the tie rods and the suspension mounts. Do you detect any movement? | ☐ | ☐ |
| 38 Are the brake pads and rotors worn out? | ☐ | ☐ |
| 39 Is there rust on any of the underbody surfaces? | ☐ | ☐ |
| 40 Check the engine bottom. Any sign of fluid leaks? | ☐ | ☐ |
| 41 What about transmission and differential leaks? | ☐ | ☐ |
| 42 Is there any bent or dented metal? | ☐ | ☐ |
| 43 Are there shiny marks on the pinch welds? | ☐ | ☐ |
| 44 Is there fluid seepage around the brake calliper or from the bottom of the brake drums? | ☐ | ☐ |
| 45 Check the ground under the car. Are there any puddles of oil or fluid? | ☐ | ☐ |
| 46 Look at the bottom of the radiator. Is it wet from coolant? | ☐ | ☐ |

USED-CAR CHECKLIST Popular Mechanics

ENGINE

	Yes	No
47 With the engine off, squeeze the hoses (be careful, they may be hot). Do they feel stiff or brittle?	☐	☐
48 Are there cracks in the belt(s)?	☐	☐
49 Are there any wires not covered by sheathing?	☐	☐
50 Are there any loose hose clamps?	☐	☐
51 Are there any loose and corroded battery clamps?	☐	☐
52 Is the battery more than 4 years old?	☐	☐
53 Is there any sign of fluid leaks at the accessories (power-steering pump, brake reservoir)?	☐	☐
54 Any evidence of nesting mice or other animals?	☐	☐
55 Is the air filter dirty?	☐	☐
56 Are fluid levels (power steering, brake, coolant, oil and transmission) below the minimum?	☐	☐
57 Check for oil change stickers. Is the car long overdue?	☐	☐
58 Is there seepage at the bottom of the brake reservoir?	☐	☐
59 Is there sludge in the bottom of the coolant reservoir?	☐	☐
60 If the engine has a timing belt, is it older than 4 years? If unknown, answer "yes".	☐	☐

DEAL BREAKER

61 Put a drop of oil from the dipstick on a clean, dry rag. Does it appear gooey or black?	☐	☐
62 Are there shiny metallic particles in the oil?	☐	☐
63 Does the oil look milky or smell like petrol?	☐	☐
64 Remove the oil filler cap. Are there thick, black deposits in the cylinder head?	☐	☐
65 Sniff the automatic transmission fluid dipstick. Does it smell burnt?	☐	☐
66 Wipe the dipstick on a clean, white rag. Are there a lot of black particles, or is the fluid dark?	☐	☐

ENGINE, ADVANCED

(Requires a more rigorous inspection; clear with owner first)

67 Check the battery for parasitic drains. Is the standby current more than 75 milliamps?	☐	☐
68 Check the voltage between the coolant and battery ground. Is it higher than 250 millivolts?	☐	☐
69 Plug in a scan tool. Are there any pending codes?	☐	☐
70 Pressure-test the cooling system. Does it leak?	☐	☐

DEAL BREAKER

71 Do a compression test. Are any of the cylinders 25 per cent lower or more than the highest?	☐	☐
72 Do a cylinder leak-down test. Do any cylinders leak more than 15 per cent?	☐	☐

POWERTRAIN STARTUP

73 Are there any strange noises (belt squeak, exhaust leak)?	☐	☐
74 Turn the key to the "on" position. Do the warning lights fail to illuminate?	☐	☐
75 Start the car. Do the warning lights remain on?	☐	☐
76 Does the airbag light stay on or blink?	☐	☐
77 Does the engine fail to settle into a consistent idle within a couple of minutes?	☐	☐
78 Automatic transmission: Put the car in drive. Does it clunk into gear?	☐	☐
79 Manual transmission: Depress the clutch. Does it feel stiff or jerky?	☐	☐

ON THE ROAD

	Yes	No
80 Drive the car in tight circles in a parking lot. Does anything rub or clunk?	☐	☐
81 Brake firmly. Does the pedal feel soft and mushy?	☐	☐
82 Does the feel of the brake pedal change (e.g., soft one stop, firm the next)?	☐	☐
83 Does the car veer to one side while braking?	☐	☐
84 Drive over some bumps at normal speeds. Does the car bounce up and down after hitting a bump?	☐	☐
85 Do you hear any loud noises from the suspension, such as clunks or creaks?	☐	☐
86 Get up to highway speeds. Is there any vibration?	☐	☐
87 Is the steering wheel off-centre when the car is going straight?	☐	☐
88 Do you hear excessive wind noise?	☐	☐
89 Do the interior pieces rattle over bumps?	☐	☐
90 Does the car pull to one side?	☐	☐
91 Accelerate briskly. Does the transmission jerk at the shift points?	☐	☐
92 Does the car accelerate in fits and starts?	☐	☐
93 Manual transmission: Put the car in top gear while driving at 50 km/h. Floor the throttle. Do the engine revs climb quickly, as if the clutch is slipping?	☐	☐

DEAL BREAKER

94 Do you hear any knocking noises from the engine that get faster with higher engine speed?	☐	☐
95 Does the car feel tired, as if it's worn out?	☐	☐

TEST DRIVE (WITH A FRIEND)

96 Have someone watch the headlamps and marker and brake lights as you operate them. Are any burned out?	☐	☐
97 With your friend standing behind the car, start the engine. Is there sustained visible smoke?	☐	☐
98 With your friend following, drive the car. Do the wheels wobble, or does the vehicle have an odd stance (e.g. it rides low in the rear)?	☐	☐
99 Is there smoke coming from the exhaust during acceleration?	☐	☐

POST-TEST-DRIVE INSPECTION

100 Look under the bonnet. Do you hear a hissing noise?	☐	☐
101 Check under the car again. Any sign of fresh fluid leaks?	☐	☐

WHAT IT MEANS

Number of "yes" answers	Conclusion
Fewer than 5	Probably a cream puff
5 to 10	Relatively easy to fix
More than 10	Potentially a time sink, but nothing serious
Fewer than 5	Nothing to fret about – it's a used car
5 to 10	Enough DIY fix-its to last a year
More than 10	Just walk away
Fewer than 3	Make a lowball offer
3 to 6	Proceed with extreme caution
More than 6	Abandon all hope, ye who enter here

DEAL BREAKER

One or more deal breakers: Dodge this bullet.

eurolux

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with
cutting
edge
energy saving
globes



Dispose of your old used globes and fluorescent tubes responsibly in the allocated dump bins, at any of our stores.



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R11⁹⁹



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Q+A

Oxygen deprivation

Q When the Check Engine light came on in my Ford, checking the code with an OBD-II scanner revealed a bad oxygen sensor. What's the best way to replace it?

A Your car's computer uses data from the O₂ sensors to determine the effectiveness of the catalytic converter and how much fuel to inject. So they're critical pieces. Luckily, replacing one is relatively straightforward.

Unfortunately, original-equipment oxygen sensors, offered by the manufacturer, can be pricey. The solution is to buy a cheaper, universal-replacement

sensor from your local spare parts outlet.

Ah, but all sensors are not the same. Older cars typically used basic units with just one wire (the wire carried the signal; the unit simply earthed to the exhaust pipe). Newer cars are fitted with heated O₂ sensors with up to four wires, allowing the sensor to reach its base 120° operating temperature more quickly. The most surefire way to buy the right replacement is to first remove the bad one and take it with you.

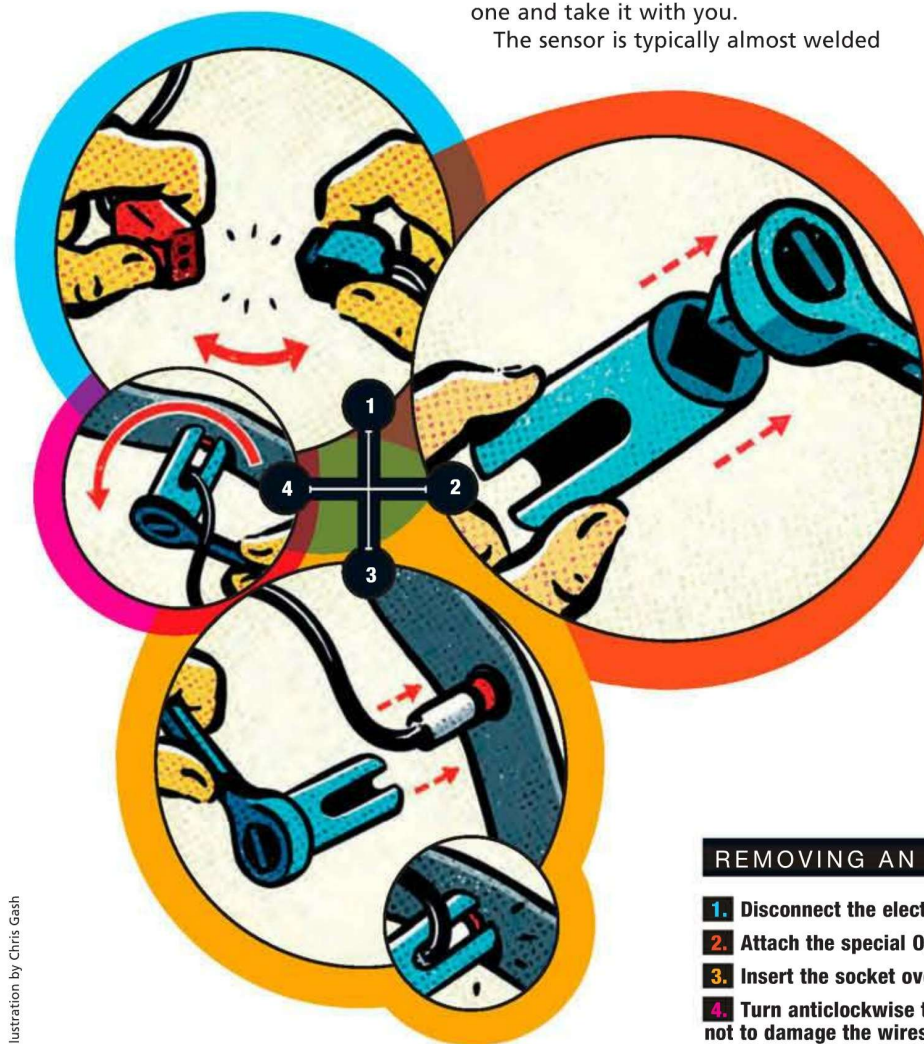
The sensor is typically almost welded

to the exhaust, so apply a liberal spray of penetrating oil to the threads of the sensor and let it loosen the joint. Unplug the sensor from the wiring harness, and get a special O₂ sensor socket from the spare parts outlet and remove the old sensor from the exhaust bung. If the sensor won't budge, try more penetrating oil or attempt the removal with the engine warm (be careful not to burn yourself).

The universal replacement may come with an adapter plug to mate the new sensor to the car's wiring harness. If so, use the adapter. Never cut the wires on O₂ sensors that come with adapters, because, interestingly, these types of sensors "breathe" through the wires. Every O₂ sensor works by comparing exhaust gas with outside air – the difference in oxygen levels creates a voltage that's read by the car's computer. As a result, cutting the wires and soldering them clogs that minute pathway and renders the sensor useless.

There are, however, some sensors that sample outside air near the unit's base and therefore come with just bare wires. If you obtain one of these, you'll need to cut the plug off the old sensor and splice it to the new one. Strip the insulation off the ends, slide sections of heat-shrink tubing over the sensor wires, and splice the joint together with solder. Finish by applying heat, sealing the joint.

Your new O₂ sensor should be handled like a piece of china. Do not allow the tip to touch anything – it may become contaminated. Apply a small amount of anti-seize to the threads and hand-tighten the sensor in the exhaust bung, being careful to keep the tip away from the sides. Use the sensor socket to tighten the O₂ sensor to three-quarters turn past finger-tight, depending on the manufacturer's recommendation. Finally, reroute the wire and attach the connector. Be sure to keep the wire from direct contact with high-heat sources. **PM**



REMOVING AN O₂ SENSOR

- 1.** Disconnect the electrical plug.
- 2.** Attach the special O₂ sensor socket.
- 3.** Insert the socket over the sensor.
- 4.** Turn anticlockwise to remove it, while being careful not to damage the wires.

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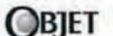


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Affordable on-line GPS tracking, remote control and data logging services

? What is locat?

Many electronic devices are capable of connecting to the internet. Apart from those very familiar gadgets - such as computers, laptops and mobile phones - many lesser-known devices also have this capability. These devices fall into two broad categories; **sensors** (those which collect data about its environment), and **controllers** (which are used to remotely switch and control). **LOCAT aims to provide a consolidated interface to a variety of such devices on a single platform.** A combination of any of the following is possible:

- **Live GPS Tracking** of animals, people, equipment, containers, vehicles, etc.
- **Remote Control** of motorized gates, pump switches, lights, etc.
- **Remote Monitoring** of on/off triggers or values such as temperature, pressure, voltage, etc.
- **Data Logging** of incoming data means that historic data is available for download or processing.
- **Notifications** of alarm conditions via email and SMS to you and your contacts.

? How is locat different from other tracking services?

- **GPS tracking isn't all we do.** Although the most popular use for locat is surely going to be as a GPS tracking service, that's certainly not all LOCAT is useful for. As the different types of devices and protocols we support increase, so does the versatility of the service. We have developed an open-ended system, and there may be applications for locat in the future that might surprise even us.
- **We do not manufacture, import, distribute, endorse, sell or install any equipment.** Unlike other services, you do not need to use "our" equipment on *our* service, nor do are you obliged to use *our* service if you were to buy "our" equipment - we simply *don't have* equipment. That said, we are enthusiastic in our promotion and support of those who do in fact sell the right kind of equipment and gadgets, and list of vendors is available on the "Shop" page of our website.
- **We do not provide any asset recovery, security or fleet management services.** These things are left to the experts. Naturally, that means that we have a much less complicated and costly infrastructure to maintain, which translates into us being able to offer our services at very affordable rates. Nevertheless, since the data can be shared, and data history can be downloaded in a number of formats at any time, there's nothing standing in the way of using locat *in conjunction with* existing systems.
- **It's community-driven to a significant extent.** Users are able to share their data with others. In the future, users will be able to offer data for sale on an open data market. The system has been developed to rapidly incorporate new protocols, new devices and new ideas about the integration of communications

? What are the costs?

Well, at this stage, **zero**. During the **free4now promotion**, currently running, we're offering users the opportunity of tracking one (or more, depending on how we feel) GPS tracker at no cost. Once we are satisfied that our systems are stable and reliable, the payment system will kick in and all registered users will be notified and given the option of continuing with the (paid) service.

LOCAT will offer its services on a monthly pre-paid basis to subscribers. The actual monthly costs depend entirely on the requirements that the user may have and the services selected by the user, but in all cases we endeavour to keep the costs as low as possible.

? How does one get started?

Basically is is simply a matter of purchasing a tracker (or other device) and adding it to your locat account. To accomplish this, you'll need:

- **A tracker** (or sensor/controller) *See our website for shopping suggestions.*
- **A SIM card** if your device requires it, which is normally the case.
- **A locat account** which is yours after successful registration.

? Does locat support device/protocol XYZ?

No, probably not yet. When we notice a foreign device, or if you let us know about a device you'd like to link, we use the tools we've developed previously to add support as quickly as we can. When the interface to you device is ready, you will be notified, and once you are satisfied that you can use your device on locat, the interface to that device will then become available to anyone else with a similar device.



More information available at www.locat.co.za

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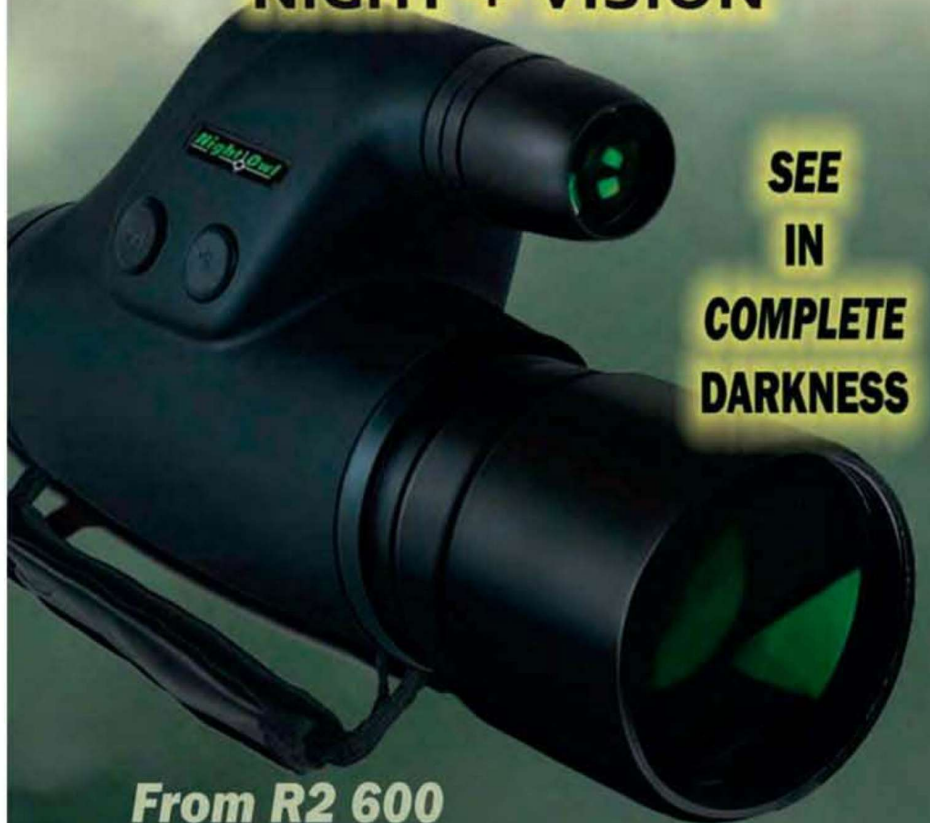


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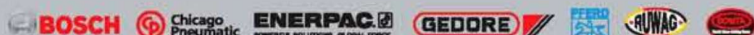
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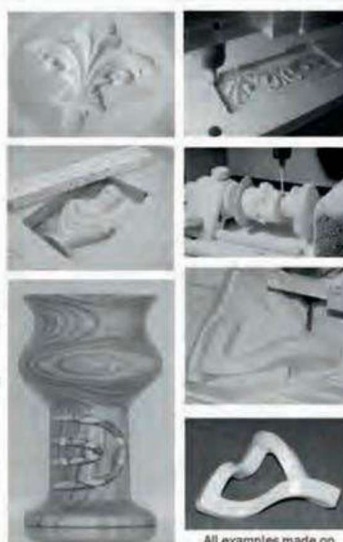
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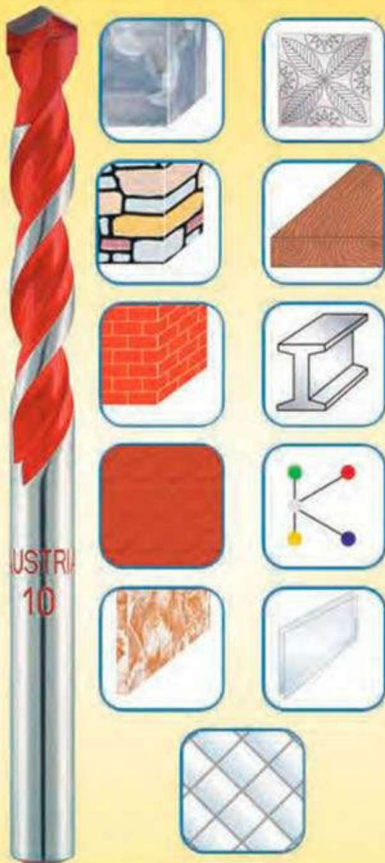
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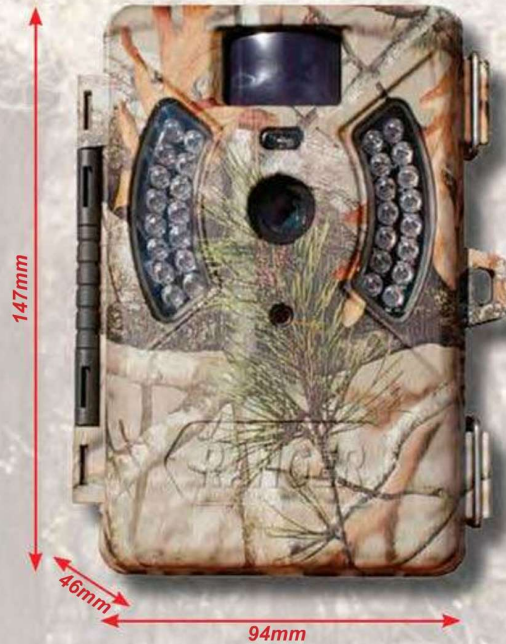
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Solo testing

If you need to test the electrics on your trailer or caravan and don't have anyone to help, try this: push the Record button on your smartphone, place it on the ground and aim the lens at the rear of the trailer, ensuring that it can "see" the various lights. Activate the taillights, brake lights and indicators in turn, then play back the video to make sure everything is working as it should. It's as easy as that.

ROBYN ESHELBY
FOURWAYS



When the NSRI won't do

I have twice managed to save my mobile phone from drowning: once when it fell into a bath, and the second time when I saw it pressed against the glass inside my washing machine during the rinse cycle. I attribute its survival to turning the phone off immediately, removing the battery, pouring out the water and shaking off the excess, then immersing it in a box of silica gel for about 24 hours. My hint: keep a box of silica gel at hand to save your phone from certain death (you can dry out the gel in your microwave between mishaps).

JANINE VICTOR
LYNNWOOD MANOR

Keep the change

Finding change for car guards at short notice can be a pain. To solve the problem, I store a few coins in my car's ashtray, pressing them edge-on into a blob of Prestik to stop them from sliding around.

AL DE BRUYN
VIA E-MAIL

Flash memory?

How often have you returned home from the supermarket only to discover that you've forgotten to buy something important? Here's my solution: use a whiteboard marker to write your list directly on to the door of your fridge (don't worry, it will wipe off without leaving a mark). Before you head out to the shops, take a photo of the list with your cellphone camera. You now have your shopping list with you for easy reference while cruising the aisles. If you don't want to risk your fridge door, a cardboard list – stuck to the door with Prestik – would work just as well.

ROD NIGHTINGALE
VIA E-MAIL

Wind-up

When you need to remove a door panel on your car (for example, to replace a smashed window), you're faced with the dreaded task of removing the window winder handle. This can be extremely challenging, and you might end up breaking the handle or losing the clip that holds the winder handle in place. The solution is to take a piece of cloth, fold it double, and work it in between the winder handle and door panel, using a sawing motion. The "legs" of the clip get caught in the cloth, popping it out with minimal fuss.

KENNETH ELLA
PRETORIA

Power trip

I recently started experiencing power trips at the electrical distribution box in the street that feeds my home. The fault appeared to be in the underground

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armoured cable, the route of which I was uncertain. I was reluctant to buy an expensive cable locator with possibly limited sensitivity, so instead I used an old portable AM radio, tuned to a quiet part of the band, to locate the 50 Hz buzz from the cable.

First, I ran a test using a visible portion of the 380 V cable to determine the directionality of the radio relative to the cable and to locate the most sensitive part of the AM band. I found that I could locate the cable to a depth of about 400 mm in sand and about 120 mm in concrete, and was able to trace the cable all the way from the distribution box to the house, even through the foundation. Of course, the cable must be energised for this to work.

DION KRIGE
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